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THE

JOURNAL

OF

THE LINNEAN SOCIETY.

BOTANY.

VOL. XXXVIII.

LONDON:
SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON HOUSE,
PICCADILLY, W.,
AND BY
LONGMANS, GREEN, AND CO.,
AND
WILLIAMS AND NORGATE.
1907–1909.

MO. BOT. GARDEN
1910

Dates of Publication of the several Numbers included in this Volume.

No. 263,	pp. 1– 80,	published	July 11, 1907.
„ 264,	„ 81–197,	„	October 14, 1907.
„ 265,	„ 198–289,	„	January 11, 1908.
„ 266,	„ 290–336,	„	June 3, 1908.
„ 267,	„ 337–394,	„	October 13, 1908.
„ 268,	„ 395–495,	„	February 15, 1909.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

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ERRATA.

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19, line 16, for *Wolfia* read *Wolffia*.
53, lines 10 & 12, *for* Ward *read* nob.
56, line 38, ,, ,, ,, ,,
59, lines 35 & 36, ,, ,, ,, ,,
92, line 2 from bottom, for *nodosum* read *nodiferum*.
92, ,, 2 ,, ,, for *Cymbella* read *Cocconema*.
96, ,, 7 ,, ,, *for* Gay *read* F. Gay.
96, ,, 2 ,, ,, *for* Roy. *read* Roy
203, ,, 3 ,, ,, *for* Rupprechti *read* Principis-Rupprechti.
229, ,, 30, for *pileatum* read *plicatum*.
231, ,, 16, for *aculeatum* read *aculeastrum*.
246, ,, 2, *for* CASSUS *read* CISSUS.
252, ,, 15, *for* IRISTEMMA *read* TRISTEMMA.
288, bottom line, *read* Füllemann.
294, line 5, *for* .— dubia, *read* .— I. dubia,
294, ,, 26, *read* 3. I. MEYENIANA, Kunth, *and delete* I. TERNATA, Dunn.
300, ,, 16 et seqq., *see* cancel-page, issued with No. 267.
333, ,, 18, *for* BRUNONIS *read* BRUNONIS.
354, ,, 17, for *fusca* read *fuscata*.
371, ,, 6, *for* Brown *read* N. E. Br.
399, ,, 7, for *Bulica* read *bulica*, Stapf.
410, ,, 15, *for* SANGUINEUS, Fr., *read* SANGUINEUS, G. F. W. Meyer.
432, ,, 31, for *lavendulacea* read *lavandulifolium*.
442, ,, 27, *for* DICTOSPHÆRIA *read* DICTYOSPHÆRIA.

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THE JOURNAL

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THE LINNEAN SOCIETY.

(BOTANY.)

The Systematic Position of *Hectorella cæspitosa*, Hook. f. By ALFRED J. EWART, D.Sc., F.L.S., Government Botanist to the State of Victoria.

(With 1 Text-figure.)

[Read 1st November, 1906.]

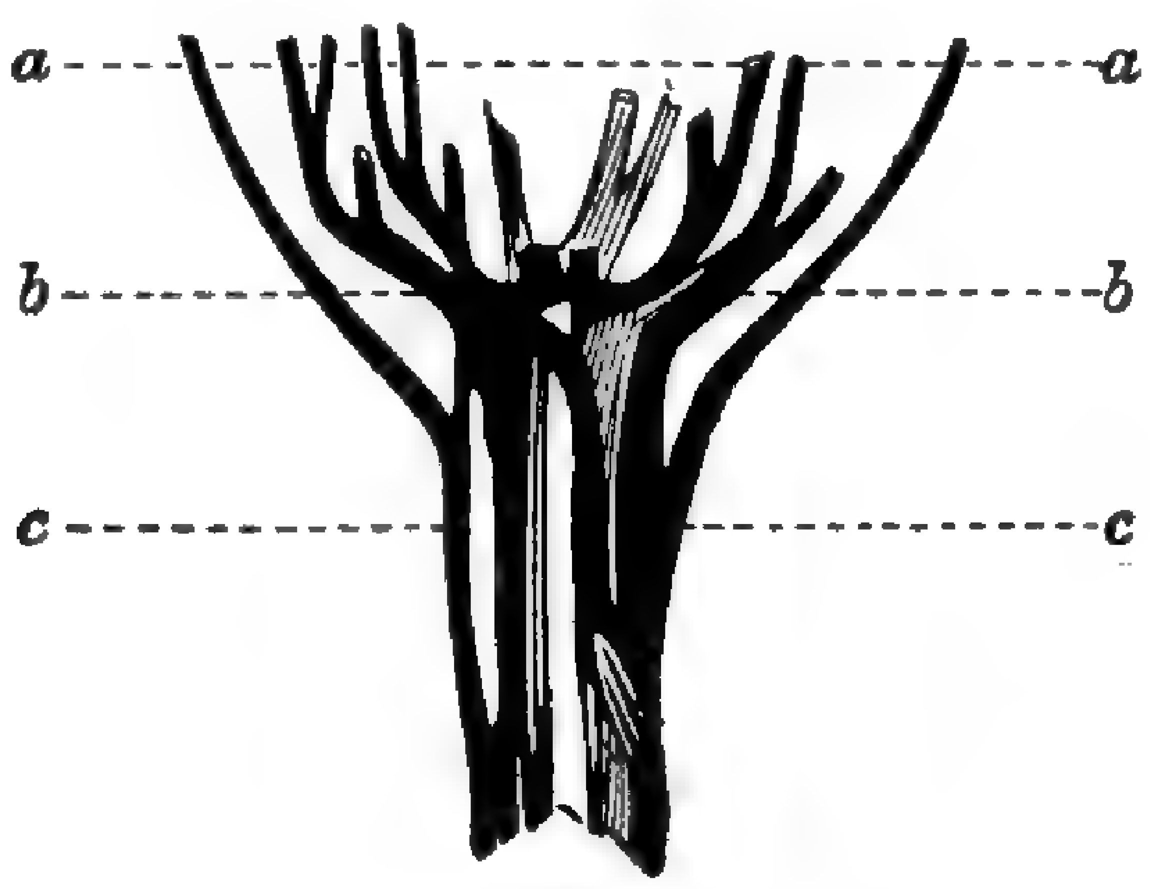
THIS interesting little plant from New Zealand was placed by Sir J. D. Hooker among the Portulacaceæ, although he considered it to be allied to no other genus (in this Order), and was aware of its strong resemblance in habit to *Lyallia* among the Alsinoideæ-Polycarpeæ group of the Caryophyllaceæ. Mr. Petrie collected a large quantity of this plant in flower and fruit, and forwarded the same to the late Baron von Mueller, who apparently was unable to subject the material to more than a superficial examination.

The fruits were unknown to Hooker, although Pax, in Engler's 'Pflanzenfamilien' (iii. 1 b, p. 58), gives the carpels as containing 4 to 5 ovules, of which a fewer number ripen in the fruit.

The following is a verified and slightly modified description from the MS. of the late Baron von Mueller :—

"Ripe fruit almost globular or somewhat turbinate, membranous, nearly as long as the sepals, and hence slightly shorter than the petals, retaining the style and stigmas for some time, bursting by irregular valves at the apex, and measuring about $\frac{1}{6}$ of an inch. Ripe seeds 2 to 4, ovate roundish, slightly compressed, smooth outside, shining black, about $\frac{1}{16}$ inch long. Endosperm scanty, curved embryo, the ends not meeting, and the cotyledons hardly longer than the radicle."

There is nothing in this description to connect *Hectorella* any more definitely with the Portulacaceæ than with the Alsinoideæ-Polycarpeæ. The chief distinction lies in the fact that in *Lyallia* the pair of leaves just beneath the base of the perianth are considered to be prophylls, and in *Hectorella* sepals. The latter is, however, an error. Of the two supposed "sepals" one can usually be seen to arise at a slightly higher level than the other as in *Lyallia*, while the vascular bundles are inserted obliquely and distinctly below the origin of those which run to the perianth and stamens. In the figure here given the line *a a* gives the point at which the perianth-segments usually separate, *b b* the level of the thalamus. The "sepals" are inserted below *b b*, and at or above *c c*. The vascular bundles of the stamens and petals vary as regards their exact origin in different flowers, but always diverge abruptly at the apex of the flattened flower-stalk, forming a distinct group of bifurcations well above the point of origin of the vascular bundles of the sepals, and splitting up at once or after a slight preliminary branching in the fused base



of the perianth. In the figure of the flower given by Pax (*l. c.* p. 53, fig. 20), the close relation of the prophylls to the flower is somewhat exaggerated, and the bluntly-pointed tips of the petals and their slight concavity are not shown, so that the flower appears more widely dissimilar from that of *Lyallia* than it really is.

In regard to the stamens, Pax doubts whether they really alternate with the perianth-segments, as stated by Hooker. The latter author is, however, correct, as the term is ordinarily understood, although when the vascular bundles of stamen and perianth-segment have a short common branch, that from the stamen may be seen to twist laterally and join the common branch from the inside, as though antipetalous, in cleared and mounted preparations showing no signs of lateral distortion. Out of the large number of flowers examined all but two had 5 stamens, the exceptions having 6 and 7 respectively, and the extra stamens being opposite to the "petals" at their junction with the perianth-tube. In regard to the stigmas, Hooker and also Pax give the number as from 1 to 3. Out of several dozen flowers examined, all but 1 had two stigmas only, the exceptional flower having one of its stigmatic

lobes partially split. Before the stigmas separate there appears to be one only, but Hooker's 1 to 3 is probably a misprint for 2 (as in *Lyallia*), very rarely 3.

Altogether there can be no doubt that *Hectorella cæspitosa* and *Lyallia kerguelensis* are closely related plants, the former being the more primitive type, and being still in a plastic condition as regards its flower. *Hectorella* is peculiar in having lost or never having developed its petals. In the former case an outer, and in the latter case an inner row of 5 stamens has probably been lost. In *Lyallia* the reduction is carried further, the seeds being reduced usually to 1, the stamens to 3, and the perianth-segments to 4, and being more distinctly united at their bases. It is worthy of note that gamophylly, indicating as it does floral specialization, is very commonly coupled with a reduction in the number of stamens.

If we include *Hectorella* with the Alsinoideæ-Polycarpeæ along with *Lyallia* and *Pycnophyllum*, the question at once arises as to whether the "sepals" in the Portulacaceæ as a whole are not capable of the same interpretation, in which case it would be difficult to avoid including the Portulacaceæ as a sub-group of the Caryophyllaceæ. That is, however, a matter for further discussion.

Platanthera chlorantha, Custor, var. *tricalcarata*, Hemsl.

By W. Botting Hemsley, F.R.S., F.L.S.

(Plate 1.)

[Read 17th January, 1907.]

In June 1906, Miss D. R. Wilson, of Pax, Sherborne, Dorset, sent to Kew a painting of a British Orchid, which she at first took to be *Platanthera bifolia*, but she afterwards came to the conclusion that it could not be that plant, because it was so different in floral structure. Awaiting a reply, Miss Wilson had fortunately preserved the specimen in water, and offered to send it to Kew if required. Naturally the offer was accepted, and Miss M. Smith has made the more detailed drawings which I now exhibit and fully illustrate the nature of the morphological transformation which the flowers have undergone. But before describing it I will give Miss Wilson's original note :—"I enclose a painting of an orchid which I found on June 12th, and which I cannot identify. It was growing among Butterfly, Tway-blade, and Spotted Orchis in a grass drive along the border of a wood. It is sweet-scented, like *Habenaria bifolia*, and at first sight I took it for that plant. On examination, however, I saw that it had three spurs, very narrow sepals, and the two lateral petals curved back like horns. The flowers are also tilted upwards, so that the lip turns up, the spurs down, and the central parts lie horizontal, not perpendicular as in other orchids."

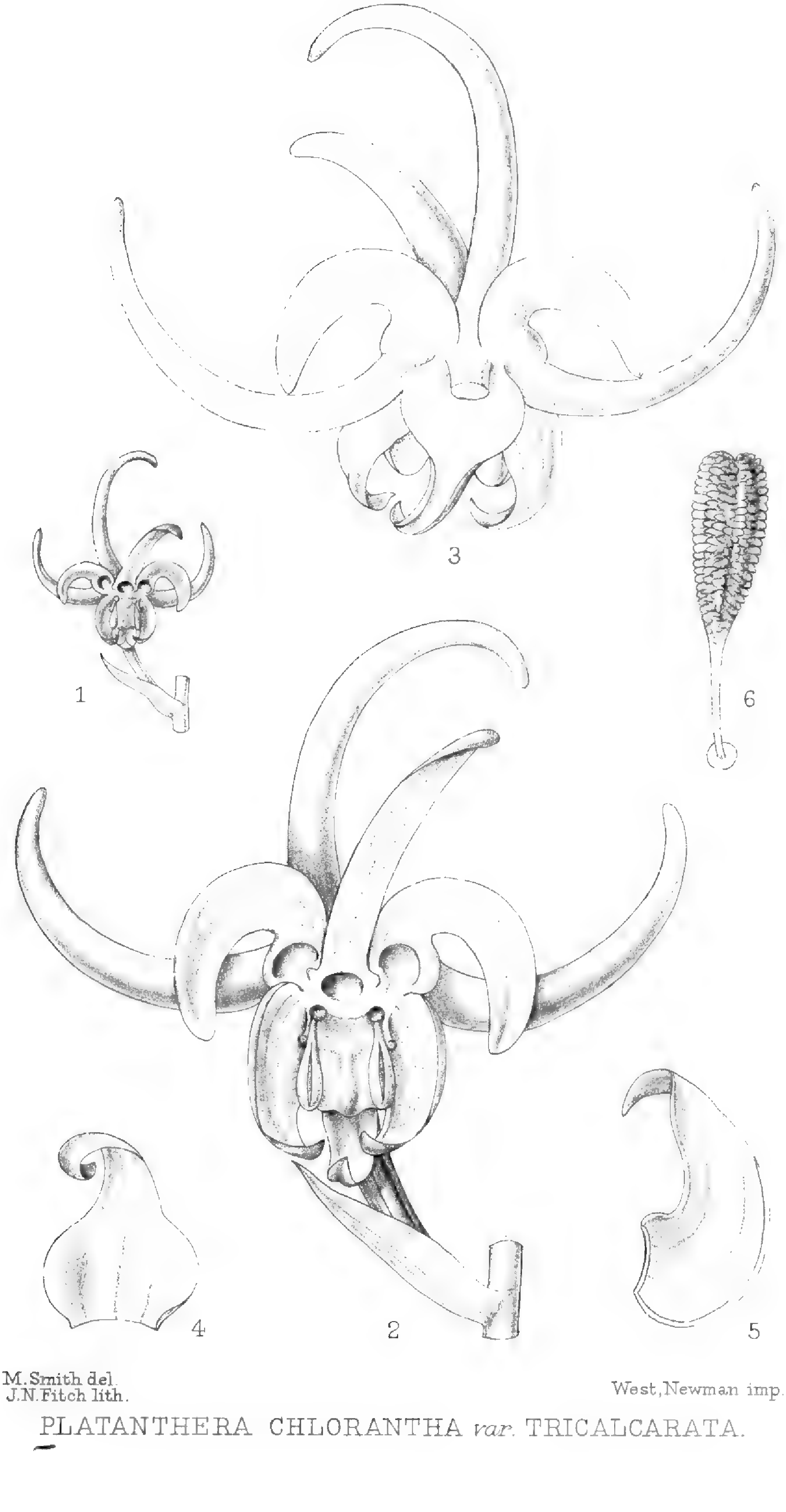
Well, there is no doubt that it is an abnormal condition or variety of *Platanthera bifolia*, as limited by some botanists; but I prefer treating *P. bifolia* and *P. chlorantha* as species, and I regard the plant in question as belonging to the latter, though the anther-cells are parallel. It presents a very rare kind of metamorphosis, namely the metamorphosis of the lateral or paired sepals into spurred organs of which the limb is unlike the lip. The only other similar instance I find recorded is of *Orchis pyramidalis*, L. (*Anacamptis pyramidalis*, Rich.), by Dr. Faggioli (Atti del Congresso Botanico Internazionale di Genova, 1892, p. 521, t. 19. ff. 11–13). I say similar, because the limb of the spurred sepals in the Orchis is enlarged, two-lobed, and the pose normal; that is, the ovary is twisted, so that the lip is lowermost.

Miss Wilson's specimen of *Platanthera chlorantha*, var. *tricalcarata* was about 22 cm. high, but only the inflorescence was saved. It bore ten flowers, all of which are modified in exactly the same way, and they are larger than ordinary *P. bifolia*.

Description.—Ovary straight. Odd sepal about 6 mm. long, broad in the lower part, then abruptly constricted and almost linear in the upper part, which is incurved over the column, with the margins recurved. Paired sepals spurred; spur cylindrical, acute, about 2 cm. long when stretched out, spreading at a right angle from the lip, curved upwards and towards the lip and forming almost a semicircle with the tip nearly as high as the orifice; limb horizontal in relation to the spur, sickle-shaped with the curve away from the lip, acute, about 1 cm. long. Petals very similar to the odd sepal, but oblique at the base with a rounded auricle extended in the direction of the lip, narrowed upwards and connivent with the odd sepal, tip incurved. Lip uppermost; limb ligulate, about 1 cm. long, nearly equal in width throughout, very obtuse and bearing one small tubercle on each side at the base; spur cylindrical or slightly compressed, about 2·3 cm. long, thickened below the middle, somewhat acute, curved away from the axis. Staminodia 2, small, adnate to the column at the base of each anther-cell, papillose at the top. Column relatively large and broad. Anther-cells distant, parallel. Caudicle nearly as long as the anther, attached to a circular gland.

From the foregoing description and the accompanying figures, it will be perceived that nearly all parts of the three-spurred flower are more or less modified, in response, apparently, to the chief modification, which occupies a larger basal area than the normal paired sepals. It is also evident that the abnormally modified flower presents one at least of the characters commonly supposed to be peculiar to *P. bifolia*, and that is the parallel anther-cells. But this modification may be a part of the general deviation from the normal condition, because the three-spurred variety has the long caudicle and circular gland of normal *P. chlorantha*.

The flowers of Orchids present probably a greater variety of deviations from the ordinary or normal structure than any other natural order of plants,



M. Smith del.
J. N. Fitch lith.

West, Newman imp.

PLATANTHERA CHLORANTHA *var.* TRICALCARATA.

which may perhaps be accounted for by the fact that the ordinary structure is very unusual owing to the suppression of parts and the singular forms assumed by those developed. Theoretically the orchid flower consists of a perianth of six parts, in two series; of six stamens, in two series; and a tricarpellary pistil. In the great majority of orchids, including *Platanthera*, the six parts of the perianth are all developed, but they often differ very much in shape in the same series, and one of the inner series differs so much from the others that it has the distinctive name of lip or labellum. On the other hand, only one stamen is usually developed.

Returning to *Platanthera bifolia* in the broad sense, that is including *P. chlorantha*, many deviations from the typical floral structure are on record, which collectively support the theory explained.

The kind of deviation just described has been designated false or irregular peloria, because the parts concerned belong to different whorls; that is to say, two of the spurred organs belong to the sepal-series and one to the petal-series. True peloria of two kinds has been observed in *Platanthera*, namely lip-peloria and petal-peloria, in which the transformed organs, being of the petal-series, are either like the lip or the lip takes the shape and colouring of the other two petals. In some instances of petal-peloria six fertile stamens are developed, thus exhibiting a reversion, may we call it, to the ordinary monocotyledonous type. Many instances of imperfect peloria are on record, such as the conversion of one of the paired petals into a lip-like organ, or, as in some cases, only one half of an organ is affected. As I have no practical knowledge of anatomical development I will not attempt an explanation of these phenomena, but I must say that it seems to me very difficult to explain whence the sepals in the three-spurred *Platanthera* derive the material for their extra development, unless we may assume the foundation of surplus-spur-material. The staminodes being present, it is not from that source that material is diverted.

Miss Wilson has written again to say that she found only one spike of the three-spurred *Platanthera*, and that was on the fringe of a wood called The Holts, which lies along a ridge of hill north of the village of Bishop's Caundle, about five miles from Sherborne.

EXPLANATION OF PLATE 1.

Figures 1 to 3 are more or less diagrammatic and the pose is not quite natural, as the median longitudinal plane of the flowers was oblique to the axis.

Fig. 1. A flower attached to the axis, natural size.
Fig. 2. The same about three times natural size, front view.
Fig. 3. Back view of the same.
Fig. 4. Odd sepal, very much enlarged.
Fig. 5. A petal, very much enlarged.
Fig. 6. A pollinium and gland, very much enlarged.

Hallieracantha, a New Genus of Acanthaceæ. By Dr. Otto Stapf, F.L.S., Principal Assistant, Herbarium, Royal Botanic Gardens, Kew.

[Read 7th February, 1907.]

The genus *Ptyssiglottis* was established by T. Anderson[1] on *Rhytiglossa radicosa*, a plant described by Nees[2] from specimens collected by Champion in Ceylon. *Rhytiglossa* comprised originally a few South African species. Subsequently the genus was considerably enlarged by the addition of other, mainly American, species, growing thereby rather heterogeneous, and at present its species are distributed over several genera. There is no doubt that T. Anderson was perfectly justified in separating the Ceylon species from *Rhytiglossa*, in whichever sense that genus may be taken. His description of *Ptyssiglottis* is, so far as it goes, unobjectionable. Unfortunately, however, he adopted Miquel's[3] view that the Ceylon *Rhytiglossa radicosa* of Nees was identical with the *Rostellularia sarmentosa* of Zollinger[4], an identification that is difficult to understand, as the description of *Rostellularia sarmentosa*, and still more the comparison of the specimens, do not suggest any close relationship. Miquel's statement did not remain unchallenged. Bentham[5] suggested that the *Rostellularia sarmentosa* of Java might be specifically distinct from *Ptyssiglottis radicosa*, and C. B. Clarke[6] more emphatically stated that the former "does not belong here," viz. to *Ptyssiglottis*. Notwithstanding those critical remarks *Ptyssiglottis* was generally enumerated as a monotypic genus inhabiting Ceylon and Java, until, in 1896, Hallier fil.[7] published two new species of *Ptyssiglottis* from Borneo and several more[8] in the following year, also from Borneo. In referring those Borneo species to *Ptyssiglottis*, he relied on a rather incomplete specimen of *Ptyssiglottis radicosa* in the Buitenzorg Herbarium and Anderson's description of that plant. Subsequently he saw the specimens of *Ptyssiglottis radicosa* in the Kew Herbarium. Referring to them he said[9] they were not sufficient to confirm the placing of his new species from Borneo in *Ptyssiglottis*.

When some years ago I was working out Haviland's and Hose's Acanthaceæ from Sarawak, several species which were evidently congeneric with Hallier's *Ptyssiglottis* attracted my attention, but also convinced me of their generic distinctness from the *Ptyssiglottis* of Ceylon. This induced me to examine

[1] In Thwaites, Enum. Pl. Zeyl. (1860) p. 235.
[2] In De Candolle's Prodr. vol. xi. (1847) p. 344.
[3] Fl. Ind. Bat. ii. (1856) p. 825.
[4] *Ex* Nees in De Candolle, *l. c.* p. 370.
[5] In Benth. & Hook. f. Gen. Pl. vol. ii. (1876) p. 1118.
[6] In Hook. f. Fl. Brit. Ind. vol. iv. (1885) p. 544.
[7] In Ann. Jard. Buitenz. vol. xiii. (1896) pp. 289–293, t. 23. figs. 2, *a–c*.
[8] In Nov. Act. Nat. Cur. lxx. (1898) pp. 212–228, tabb. 9–16.
[9] In Bull. Herb. Boiss. vol. vi. (1898) p. 622.

the whole group, which is fairly well represented at Kew. Through the courtesy of Professor Radlkofer I had, further, an opportunity of seeing the originals of Hallier's *Ptyssiglottis* so far as they are preserved in the Munich Herbarium, whilst the late M. Drake del Castillo sent me a fragment of Zollinger's original of *Rostellularia sarmentosa*, of which, moreover, an excellent duplicate specimen was subsequently discovered by Mr. C. B. Clarke in the Kew Herbarium, where it had been placed in *Justicia*.

Rostellularia sarmentosa was easily recognized as a species of *Rungia*, and named *R. sarmentosa* by the late C. B. Clarke. All the Borneo plants described by Hallier f. as species of *Ptyssiglottis* were found to be closely connected members of a very homogeneous group, which, for reasons stated below, could not well be retained in *Ptyssiglottis*. On the other hand, the only non-Borneo *Ptyssiglottis* described by Hallier, *P. picta*, a native of North-east Sumatra, exhibited differences in the pollen, which suggested other affinities. The material of this species in the Munich Herbarium was, however, too scanty to warrant a more definite statement. But when last year Mr. C. B. Clarke examined the Calcutta set of Acanthaceæ from the Malayan Peninsula, he found among them several species which he comprised under the new genus *Polytrema*, and I have no doubt that *Ptyssiglottis picta* will have to be referred to it. If we exclude therefore *Ptyssiglottis radicosa* and *P. picta*, all of Hallier's *Ptyssiglottis* appear confined to Borneo, and more especially to the Kapuas Basin of West and Central Borneo. That area is considerably extended through the accession of not less than ten additional species from Sarawak, including Brunei and British North Borneo, and one species from Mindanao. For this group, which thus includes eight species described by Hallier and eleven to be described below, I propose the name *Hallieracantha*. Compared with many other genera of Acanthaceæ, it has the merit of being very homogeneous and also of having a continuous and uniform distribution area. It is more difficult to define its exact position in the family. Its relationship with *Polytrema* is manifest, and botanists who prefer larger genera with subgenera as subdivisions may feel inclined to reduce *Polytrema* to a subgenus of *Hallieracantha*, as the two genera differ only in the shape of the corolla, the attachment of the anther-cells on the connective, and the structure of the pollen. On the other hand, the relationship of *Hallieracantha* and *Ptyssiglottis* seems to be much more remote. *Ptyssiglottis* has been placed by Lindau[1] near *Codonacanthus* in *Pseuderanthemeæ*, and I would leave it there for the present; whilst *Hallieracantha* seems to have more in common with the *Justicieæ* (Lindau) than with the *Pseuderanthemeæ*; and Bentham[2], who placed two of Motley's plants which I describe below as *Hallieracantha Motleyi* and *H. laxa* in *Dianthera*, was not so far wrong. A closer examination of the very heterogeneous genus *Justicia* (heterogeneous

[1] In Engl. & Prantl, Natürl. Pflanzenf. vol. iv. 3 b (1895) p. 33

[2] In Bentham & Hook. f. Gen. Plant. vol. ii. p. 1114.

also in regard to pollen-structure) will probably give the key to the phylogenetic position of *Hallieracantha.*

Before proceeding to the purely descriptive part of the paper, I would indicate the characters which distinguish *Hallieracantha* and *Ptyssiglottis.* They concern mainly the inflorescence, the corolla, and the pollen. The inflorescences of *Hallieracantha* are axillary or rarely pseudoterminal, loose or much contracted, and made up of dichotomously arranged dichasia. Those of *Ptyssiglottis* are terminal and represent few-flowered, more or less one-sided racemes. The corolla of *Hallieracantha* consists of a tube which is somewhat obliquely widened in the upper part and a typically bilabiate limb, in most species three to five times shorter than the tube. The upper lip is very shortly, the lower more deeply lobed, and the latter has two conspicuous vaulted ridges on the palate. On the other hand, the corolla of *Ptyssiglottis* is obliquely companulate, with a very short cylindrical tube at the base ; it has a wide mouth, and the lobes of the limb are much less unequal than in *Hallieracantha,* nor is there a distinct vaulted palate. In *Hallieracantha* the stamens spring from the middle of the tube, in *Ptyssiglottis* the insertion is considerably lower down. The pollen of *Hallieracantha* is throughout ellipsoid, in *Ptyssiglottis* globose. I may add that the leaves of *Ptyssiglottis* are thin and of a texture such as does not occur in *Hallieracantha.* The characters given here for *Hallieracantha* are common to all its species, and it is their constant correlation that marks the genus as distinct from *Ptyssiglottis.*

HALLIERACANTHA, *Stapf.*

Calyx fere ad basin 5-partitus (rarissime 5-dentatus), segmentis æqualibus linearibus vel subulatis. *Corolla* bilabiata ; tubus limbo plerumque 3–5plo, rarius tantum 2plo longior, infra medium magis minusve cylindricus, superne sensim ampliatus ; labium superum erectum, emarginatum vel breviter 2-lobum ; labium inferum superum æquans vel subæquans, 3-lobum, lobis subæquilongis, lateralibus oblongis vel ovatis, intermedio latiore in alabastro extimo ; palatum 2-plicato-fornicatum. *Stamina* 2, medio tubo vel paulo supra orta, e corollæ tubo vix exserta; filamenta glabra; antheræ 2-loculares thecis æqualibus vel rarius inæqualibus oblongis muticis subparallelis dorso connectivo angusto eadem altitudine (vel una quam altera paulo altius) adnatis subcontiguis. *Pollen* ellipsoideus, poris 3 æquatorialibus plicæ tenuissimæ polos haud attingenti impositis plerumque plicis accessoriis utrinque singulis additis, exinio tenuissime punctato vel raro lævi ; staminodia nulla. *Discus* annularis vel breviter tubulosus, ovarium arcte cingens. *Ovarium* glabrum vel parce papilloso-pilosulum ; loculi 2-ovulati ; stylus filiformis, glaber ; stigma punctiforme vel paulo dilatatum. *Capsula* clavata oblonga, acuminata vel apiculata, ad fere medium solida, coriaceo-indurata. *Semina* lenticularia, tenuiter scrobiculata.—Herbæ *erectæ vel procumbentes, simplices*

vel ramosæ, isophyllæ vel anisophyllæ vel specie alternifoliæ. Flores *minores, albi palato plerumque luteo.* Inflorescentiæ *axillares vel pseudo-terminales, plerumque dichotomæ, ramulis apice dichasia* 1-, *rarius 2-flora gerentibus, laxæ vel admodum abbreviatæ et tunc plerumque ob bracteas dense imbricata strobilos parvos referentes.*

Species 19, in Borneo et (una) in Insulis Philippinis.

Antherarum thecæ valde inæquales; pollinis exinium læve; plantæ isophyllæ.
- Calyx 5-dentatus; inflorescentia longe pedunculata, multiflora, capituliformis; herba erecta, elata, undique molliter hirsuta .. 1. *hirsuta.*
- Calyx 5-partitus; inflorescentia modice pedunculata, pauciflora, laxa; herba prostrata, radicans, subglabra .... 2. *auriculata.*

Antherarum thecæ æquales; pollinis exinium minute foveolato-punctatum.
- Inflorescentiæ paucifloræ, laxæ, graciliter pedunculatæ; folia tenuia, exsiccando viridia; herbæ eximie anisophyllæ vel specie alternifoliæ.
  - Folia normalia petiolata; folia redacta lamina distincta munita.
    - Folia redacta uti normalia late lanceolatæ .... 3. *dulcamarioides.*
    - Folia redacta cordato-orbicularia, a normalibus maxime diversa .... 4. *Creaghii.*
  - Folia normalia subsessilia; folia redacta minuta, subulata .... 5. *laxa.*
- Inflorescentiæ subsessiles vel breviter pedunculatæ, contractæ, sæpe imbricato-squamatæ, plerumque sub apice ramulorum florem 1–2 gerentes; folia firma vel crassiuscula (*H. leptoneura* excepta), sæpissime exsiccando fuscescentia vel nigricantia.
  - Isophyllæ.
    - Folia late vel elliptico-lanceolata, fuscescentia.
      - Folia 14–20 cm.: 5–6·5 cm., utrinque acuminatæ; caulis glaber .... 11. *psychotriifolia.*
      - Folia 5–9 cm.: 2–3·5 cm., utrinque acuta; caulis undique villosulo-puberulus .... 9. *Motleyi.*
    - Folia anguste lanceolata, exsiccando fere atra; caulis glaberrimus .... 6. *salicifolia.*
  - Anisophyllæ.
    - Folia redacta lanceolata vel subulata, sæpe fugacia; herbæ erectæ.
      - Folia normalia 5–13 cm. longa.
        - Folia lanceolata, acuminata.
          - Folia crassiuscula; caulis lineis binis puberulis rotata.. 7. *lanceolata.*
          - Folia tenuia; caulis glaber .... 8. *leptoneura.*
        - Folia elliptica vel oblongo-elliptica, acuta vel subacuminata .... 10. *Beccarii.*
      - Folia normalia 12–25 cm. longa.
        - Folia lanceolata, 3–4plo longiora quam lata, costa latiuscula et uti nervi subtus prominentibus.
          - Folia pallide viridia, subtus uti caulis (secus lineas binas) et calyx minute puberula .... 12. *philippinensis.*
          - Folia saturate viridia uti tota planta glabra .... 13. *procridifolia.*

Folia elliptica vel elliptico-lanceolata, 2–2·5plo longiora quam lata, costa nervisque tenuibus.
Petioli ad 5 mm. longi; calyx 4–4·5 mm. longus . . . . . . 14. *micropollinia.*
Petioli 10–17 mm. longi; calyx 7–9 mm. longus.
Folia tenuiter caudato-acuminata; nervi laterales utrinque 6–10; venæ tenues, laxe anastomosantes . . . . 15. *caudata.*
Folia acuminata; nervi laterales utrinque 13–15; venæ prominulæ, arcte anastomosantes . . . . 16. *frutescens.*
Folia redacta rotundata, cordato-ovata (imprimis parium superiorum); herbæ procumbentes, radicantes.
Folia normalia oblongo-lanceolata, subacuminata . . . . 17. *dispar.*
Folia normalia elliptica, apice obtusa.
Folia normalia basi obtusa, uno latere acuta altero obtusa, triste viridia, exsiccata cystolithis granulata . . . . 18. *granulata.*
Folia normalia basi oblique subcordata, nigrescentia, bullata, in bullarum centris albo-maculata, exsiccata cystolithis striolata . . . . 19. *anisophylla.*

1. **Hallieracantha hirsuta,** *Stapf.*

Syn. *Ptyssiglottis hirsuta,* Hall. f. in Nov. Act. Nat. Cur. vol. lxx. (1898) p. 217, tab. 14. f. 2.

Central Borneo: Upper Kapuas Basin, upper reaches of the Mandae River; near Nanda Raun, *Hallier*, B. 2589, and on Mount Liang Gagang, from the foot to 700 m., in damp shady virgin forest, *Hallier*, B. 2588!

2. **H. auriculata,** *Stapf.*

Syn. *Ptyssiglottis,* Hall. f. in Ann. Jard. Buitenz. vol. xiii. (1896) p. 292, and in Nov. Act. Nat. Cur. *l. c.* p. 219, tab. 14. f. 3.

Central Borneo: at the foot of Mount K'lamm near Sintang, in shady bamboo thickets, *Hallier*, B. 2291!

3. **H. dulcamarioides,** *Stapf* (sp. nov.).

Herba anisophylla in superiore quidem parte sicca viridis vel fusco- vel fulvo-viridis. *Caulis* teres (juniores exsiccando sulcati), magis minusve anfractus, in lineis e commissuris decurrentibus minutissime fulvo-villosulus. *Folia* petiolata, lanceolata vel oblongo- vel elliptico-lanceolata, sæpe obliqua, breviter acuminata vel minore sæpe vix acuminato, basi acuta, majora 7–10 cm. longa, 2–4 cm. lata, minora 1·5–3 cm. longa, 0·6–1 cm. lata vel in paribus inferioribus multo maiora, integra, vel obscure undulata, tenuia, utrinque glabra, cystolithis minute striolatis, nervis utrinque circiter 6–8 tenuibus valde prorsus curvatis; petiolus gracilis, foliorum majorum 1–2 cm. longus. *Inflorescentiæ* pedunculo ad 12 mm. longo tenui suffultæ, plerumque bifurcatæ, dense vel laxe bracteatæ; bracteæ ovato-lanceolatæ, acutæ, 1–1·5 mm. longæ, papilloso-pilosulæ; pedicelli tenues, ad 4 mm. longæ,

patule glanduloso-pilosulæ. *Calyx* fere ad basin 5-partitus, 5·5–6·5 mm. longus, patule glanduloso-pilosulus, fusco-viridis ; segmenta subulato-linearia. *Corolla* 9 mm. longa, extus papillosa ; tubus 6 mm. longus ; labium superum late ovatum, breviter 2-lobum ; labium inferum supero sublongius, vix ad medium 3-lobum, lobis lateralibus oblongis, intermedio latissimo rotundato. *Staminum* thecæ æquales et æqualiter affixæ, basi obtusæ vel subacutæ. *Pollen* 42–49 μ longus, 28–33 μ latus, plicis accessoriis nullis, exinio tenuissime punctato.

SARAWAK : near Kuching, *Haviland*, 792 ! 3512 !

4. **H. Creaghii,** *Stapf* (sp. nov.).

Herba erecta, anisophylla, sicca triste viridis. *Caulis* subteres, superne sulcatus, in lineis binis e commissuris decurrentibus minutissime puberulus, demum glabratus. *Folia normalia* petiolata, late lanceolata vel elliptico-lanceolata, utrinque acuminata, 12–18 cm. longa, 3–6 cm. lata, supra glabra, cystolithis striolata, subtus in nervis (basin versus quidem) minute papilloso-pubescentia nervis lateralibus utrinque 7–8 uti venis tenuibus ; petiolus ad 10 mm. longus, minute pubescens ; *folia redacta* rotundato-ovata vel orbicularia, basi cordata, 3–4 mm. longa, subsessilia. *Inflorescentiæ* pallide virides, pedunculo gracili ad 2·5 cm. longo suffultæ, bifurcatæ, laxæ, undique puberulæ ; bracteæ lineari-lanceolatæ, acutæ, ad 2·5 mm. longæ ; pedicelli 3 mm. longi. *Calyx* fere ad basin 5-partitus, 4 mm. longus, glanduloso-puberulus ; segmenta lineari-subulata, acuta. *Corolla* 12–13 mm. longa, extus glabra ; tubus 9 mm. longus ; labium superum late ovatum, breviter bilobum ; labium inferum supero æquilongum, profunde 3-lobum, lobis lateralibus oblongis obtusis quam intermedio rotundato-ovato multo angustioribus. *Staminum* thecæ æquales, una quam altera paulo altius affixa, subparallelæ, 1 mm. longæ, inferior basi acuta ; pollen 50–53 μ longus, 35 μ latus, plicis accessoriis tenuissimis utrinque vel in uno latere tantum singulis, exinio tenuissime punctato.

BRITISH NORTH BORNEO : Sandakan District, *Creagh* !

5. **H. laxa,** *Stapf* (sp. nov.).

Syn. *Dianthera* sp., Benth. in Benth. & Hook. f. Gen. Plant. vol. ii. p. 1114.

Herba erecta, 15–35 cm. alta, ob folium alterum uniuscuiusque paris rudimentarium subulatum deciduum specie alternifolia, sicca læte viridi. *Caulis* teres, glaber vel in lineis binis e commissuris decurrentibus tenuissimis brevissime villosulus. *Folia normalia* brevissime petiolata vel sessilia, oblonga vel elliptico-oblonga, interdum obliqua, acuminata, basi acuta, 9–13 cm. longa, 3–4·5 cm. lata, glabra, tenuia, cystolithis inconspicuis striolata, nervis tenuibus lateralibus utrinque circa 7 valde prorsus curvatis ; petiolus nullus, raro 1–1·5 mm. longus. *Inflorescentiæ* pedunculo tenui ad 2·5 cm. longo suffultæ,

plerumque bifurcatæ, sæpe laxæ, ramis ad 12 mm. longis vel brevibus, internodiis 1–4 mm. longis ; bracteæ lanceolatæ, acutæ, 1–1½ mm. longæ, virides, glabræ ; pedicelli ad 3·5 mm. longi. *Calyx* fere ad basin 5-partitus, ad 5 mm. longus, viridis, glanduloso-puberulus ; segmenta subulata, acuta. *Corollæ* 20 mm. longa ; tubus 7 mm. longus ; labium superum late ovatum, breviter 2-lobum ; labium inferum supero paulo longius, ultra medium 3-lobum, lobis lateralibus oblongis quam intermedio rotundato-ovato multo angustioribus. *Staminum* thecæ æquales, subæqualiter affixæ, 1·6 mm. longæ, basi obtusæ. *Pollen* 45–46 μ longus, 25–35 μ latus, plicis accessoriis nullis, exinio tenuissime punctato.

LABUAN : Kolong Kolong hills, in deep shade, *Motley* ! *Barber*, 334 !

6. **H. salicifolia,** *Stapf* (sp. nov.).

Herba erecta, ramosa, isophylla, calycibus exceptis glaberrima, sicca nigricans vel fere atra. *Caulis* subteres. *Folia* petiolata, lanceolata, tenuiter longe acuminata, basi acuta, 7–12 cm. longa, 1·5–2·5 cm. lata, crassiuscula, cystolithis inconspicuis multo-striolata, nervis lateralibus tenuibus utrinque 6–7 valde curvatis ; petiolus ad 1 cm. longus, gracilis. *Inflorescentiæ* brevissimæ, simplices vel furcatæ, pedunculo ad 6 mm. longo suffultæ, densissime bracteatæ ; bracteæ lanceolato-subulatæ, acutæ, 3 mm. longæ, nigricantes ; pedicelli tenues, circiter 2 mm. longi. *Calyx* fere ad basin 5-partitus, 10–12 mm. longus ; segmenta linearia, acuta, apice pilosula. *Corolla* 13–14 mm. longa, glabra ; tubus 8 mm. longus, labium superum late ovatum, emarginatum ; labium inferum supero æquilongum, breviter 3-lobum, lobis lateralibus ovato-oblongis quam intermedio rotundato vix longioribus. *Staminum* thecæ æquales, subæqualiter affixæ, parallelæ, basi obtusæ. *Pollen* 49–55 μ longus, 35–36 μ latus, plicis accessoriis utrinque singulis, exinio minutissime punctato. *Capsula* oblonga, acuta acuminata, stipite paulo breviore crassiusculo incluso 12–14 cm. longa. *Semina* 2·5 mm. longa.

SARAWAK : Mount Buan, on limestone, *Haviland*, 2032 !

7. **H. lanceolata,** *Stapf.*

Syn. *Ptyssiglottis lanceolata*, Hall. f. in Nov. Act. Nat. Cur. vol. lxx. (1898) p. 221, tab. 15. fig. 1.

WEST BORNEO : Delta of the Kapuas River, near Suka Lanting, in shady forest, *Hallier*, B. 82, B. 177.

SARAWAK : Niah, *Haviland & Hose*, 3546 ! Baram, *Hose*, 120 ! *Haviland & Hose*, 3548 ! Marudi River near Claudetown, *Hose*, 169 ! 285 ! 300 !

I have not seen Hallier's specimens, and their identification with those of Haviland and Hose rests therefore entirely on Hallier's description and figure of *Ptyssiglottis lanceolata*. If I am right, *Hallieracantha lanceolata* is more variable than the other species of the genus.

8. **H. leptoneura,** *Stapf.*

Syn. *Ptyssiglottis leptoneura,* Hall. f. in Nov. Act. Acad. Nat. Cur. vol. lxx. (1898) p. 222, tab. 12. fig. 2.

West Borneo : near the Kapuas River, *Teysmann,* 7918 ; near the Melawi River (tributary of the Kapuas), *Teysmann,* 7923.

9. **H. Motleyi,** *Stapf* (sp. nov.).

Syn. *Dianthera* sp., Benth. in Benth. & Hook. f. Gen. Pl. vol. ii. p. 1114.

Herba erecta, isophylla, sicca nigricans. *Caulis* circiter 18 cm. altus, subteres, undique villosulo-puberulus. *Folia* petiolata, elliptico-lanceolata, utrinque acuta vel apice subacuminata, margine interdum subundulata 5–9 cm. longa, 2–3·5 cm. lata, supra glabra, cystolithis sæpe inconspicuis striolatis, subtus in nervis minute fulvo-furfuraceis, nervis lateralibus utrinque 4–6 prorsus curvatis ; petiolus fulvo-furfuraceus, 2–4 mm. longus. *Inflorescentiæ* axillares vel pseudoterminales, simplices vel bifurcatæ, pedunculatæ, ob bracteas dense imbricatas strobiliformes, perpauciflores ; pedunculus ad 7 mm. longus ; bracteæ ovatæ vel lanceolatæ, acutæ, 1–2 mm. longæ, herbaceæ, nigricantes, sparse furfuraceæ ; pedicelli 3–5 lin. longi. *Calyx* fere ad basin 5-partitus, ad 7 mm. longus, nigricans, furfuraceo-puberulus ; segmenta subulata, acuta. *Corolla* 7–10 mm. longa, extus papillosa ; tubus 4–6 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum supero vix longius, fere ad medium 3-lobum, lobo intermedio rotundato lateralibus multo angustioribus. *Staminum* thecæ æquales, inæqualiter affixæ, basi obtusæ, 1 mm. longæ. *Pollen* 50 μ longus, 35 μ latus, plicis accessoriis utrinque singulis, exinio tenuissime punctato. *Ovarium* minute papillosum vel glabrum (?). *Capsula* juvenilis appresse minute papillosa.

Labuan : near Sanjong Kubong, in deep shade, not uncommon, *Motley,* 123 ! ; near Sungei Tragan, on damp, shady banks, *Barber,* 273 !

Sarawak : Baram District, by the Entoyout River, near Claudetown, *Hose,* 460 !

10. **H. Beccarii,** *Stapf* (sp. nov.).

Herba erecta vel basi prostrata, ob folium alterum uniuscuiusque paris minutum mucroniforme vel subulatum deciduum specie alternifolia, sicca fusco-viridis. *Caulis* subteres, in lineis binis e commissuris decurrentibus minutissime sparseque furfuraceus. *Folia normalia* petiolata, elliptica vel oblongo-elliptica, utrinque acuminata vel basi subacuta, interdum obliqua, magnitudine varia, ad 15 cm. longa, ad 6·5 cm. lata, integra, subundulata vel crenulata, supra glaberrima, subtus sparse adpresse papilloso-pubescentia, cystolithis inconspicuis, nervis lateralibus utrinque 5–7 valde prorsus curvatis ; petioli inferiores ad 1 cm. longi, superiores multo breviores vel fere nulli,

minute furfuracei. *Inflorescentiæ* breviter pedunculatæ, simplices vel bifurcatæ, ob bracteas dense imbricatas strobiliformes, perpauciflores ; pedunculus ad 4 mm. longus ; bracteæ ovatæ vel lanceolato-ovatæ, acutæ vel acuminatæ, 1–2 mm. longæ, furfuraceæ vel glabratæ vel nigrescentes ; pedicelli 1–2 mm. longi. *Calyx* fere ad basin 5-partitus, 4–4·5 mm. longus, nigricans, parce vel copiose papilloso-pubescens ; segmenta e basi paulo dilatata subulata. *Corolla* 11–13 mm. longa, extus papillosa ; tubus 8 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum superum vix æquans, breviter 3-lobum, lobis lateralibus ovatis intermedio rotundato multo latiore. *Staminum* thecæ æquales, æqualiter affixæ, obtusæ, 2 mm. longæ. *Pollen* 45–50 μ longum, 38 μ latum, exinio tenuissime punctato, plicis longis accessoriis utrinque 2. *Ovarium* glabrum.

SARAWAK : without precise locality, *Beccari*, 1053 ! *Haviland*, 571 !

11. **H. psychotriifolia**, *Stapf* (sp. nov.).

Herba isophylla, sicca luride fusca. *Caulis* teres, glaber. *Folia* petiolata, late lanceolata, utrinque acuminata, apice obtusiuscula, 14–20 cm. longa, 5–6·5 cm. lata, margine obscure undulata, utrinque glabra, supra cystolithis striolata, nervis lateralibus utrinque 5–6 tenuibus valde prorsus curvatis ; petiolus 3–4 mm. longus, supra canaliculatus, papillosus. *Inflorescentiæ* pedunculatæ, plerumque geminatæ, interdum bifurcatæ, ob bracteas densissime imbricatas tetrastichas strobiliformes ; pedunculus ad 7 mm. longus ; bracteæ ovatæ, acutæ, 1–1·5 mm. longæ, subglabræ, nigricantes ; pedicelli tenues, ad 3 mm. longi. *Calyx* fere ad basin 5-partitus, 4·5 mm. longus, glanduloso-puberulus ; segmenta subulata. *Corolla* 12 mm. longa, extus parce minutissime papillosa ; tubus 8–9 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum supero subæquilongum, ad medium 3-lobum, lobis lateralibus oblongis intermedio rotundato-quadrato æquilongis. *Staminum* thecæ æquales, subæqualiter affixæ. *Pollen* 42–45 μ longus, 30 μ diametro, plicis accessoriis utrinque singulis, exinio tenuissime punctato. *Capsula* oblonga, breviter acuminata, in stipitem subæquilongum attenuata, eo incluso 16 mm. longa, parce minutissime papillosa.

SARAWAK : Brunei, near the Limbang River, *Haviland*, 576 ! *Hose*, 760 !

12. **H. philippinensis**, *Stapf* (sp. nov.).

Herba parce ramosa, ob folium alterum uniuscuiusque paris rudimentarium vel suppressum specie alternifolia, sicca pallide luride viridis. *Caulis* obtuse quadrangularis, lineis binis e commissuris decurrentibus villosulus, præterea glaber. *Folia normalia* petiolata, late lanceolata, acuminata, basi acuta, 12–18 cm. longa, 2·5–5·5 cm. lata, obscure undulata, supra glabra, infra in nervis minute papilloso-pubescens, utrinque cystolithis striolata, nervis lateralibus utrinque circiter 7 supra tenuibus subtus uti costa validiuscula

prominentibus valde obliquis ; petiolus crassiusculus, ad 7 mm. longus, superne canaliculatus, papilloso-villosulus. *Inflorescentiæ* axillares et specie terminales, plerumque geminatæ, interdum bifurcatæ, cylindricæ, strobiliformes, pauci-floræ, ad 1·5 cm. longæ ; pedunculus tenuis, 0·5–1·2 cm. longus ; bracteæ ovatæ, acutæ, 1–1·5 mm. longæ ; pedicelli ad 4 mm. longi. *Calyx* fere ad basin 5-partitus, 8 mm. longus, glanduloso-puberulus ; segmenta subulata, setaceo-attenuata. *Corolla* ad 15 mm. longa, extus papillosa ; tubus ad 12 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum supero subæquilongum, fere ad medium 3-lobum, lobis lateralibus ovatis, intermedio rotundato-quadrato paulo longiore. *Staminum* thecæ subinæqualiter affixæ, æquales, basi obtusæ. *Pollen* 44–48 μ longum, 32 μ diametro, plicis accessoriis utrinque singulis, exinio tenuissime punctato. *Capsula* oblonga, acuta, papillosa, in stipitem æquilongum attenuata, eo incluso 13–14 mm. longa. *Semina* lenticularia, vix 2 mm. longa, minute rugulosa.

PHILIPPINES : Mindanao, Zamboanga, *Vidal*, 3408 !

13. **H. procridifolia**, *Stapf.*

Syn. *Ptyssiglottis procridifolia*, Hall. f. in Nov. Act. Nat. Cur. vol. lxx. (1898) p. 223, tab. 16. fig. 1.

WEST BORNEO : at the foot of Mount K'lamm near Sintang, in high forest, *Hallier*, B. 2512.

14. **H. micropollinia**, *Stapf* (sp. nov.).

Herba ob folium alterum uniuscuiusque paris minutissimum vel suppressum specie alternifolium, sicca fusco-viridis. *Caulis* subteres, superne magis minusve anfractus, minute villosulo-pubescens vel furfuraceus. *Folia normalia* petiolata, oblique elliptica vel obovato-elliptica, longe acuteque acuminata, basi acuta, 13–20 cm. longa, 5–9·5 cm. lata, integra vel crenulato-undulata, supra glaberrima, subtus in nervis parcissime papilloso-pubescentia vel glabrata, cystolithis inconspicuis, nervis lateralibus 6–8 valde prorsus curvatis ; petiolus ad 5 mm. longus, minute furfuraceus. *Inflorescentiæ* plerumque plures in axillis foliorum, sessiles vel pedunculo communi ad 4 mm. longo suffultæ ob bracteas plerumque dense imbricatas strobiliformes; bracteæ ovatæ vel lanceolato-ovatæ, acutæ vel acuminatæ, 1–2 mm. longæ, parce minutissime papillosæ ; pedicelli 2–3 mm. longi. *Calyx* fere ad basin 5-partitus, 4–4·5 mm. longus, parcissime papillosus ; segmenta subulata. *Corolla* ad 10 mm. longa, extus papillosa ; tubus 5–6 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum superum æquans, ultra tertiam partem 3-lobum, lobis lateralibus oblongis subdivaricatis, intermedio ovato-rotundato. *Staminum* thecæ æquales, subæqualiter affixæ, basi obtusæ, 1·5 mm. longæ. *Pollen* 35 μ longum, 25 μ diametro, plicis accessoriis utrinque singulis, exinio tenuissime punctato. *Capsula* oblonga, acuminata, in stipitem

subæquilongum attenuata, eo incluso 14–16 mm. longa, superne papillosa. *Semina* 3 mm. longa, minute rugulosa vel scabra.

SARAWAK : Mt. Koum, *Haviland*, 1717 !

15. **H. caudata**, *Stapf* (sp. nov.).

Herba ob folium alterum uniuscuiusque paris rudimentarium subulatum specie alternifolium, sicca nigricans vel fere atra. *Caulis* teres, lineis binis e commissuris decurrentibus tenuibus tenuissime puberulis exceptis glaber. *Folia normalia* petiolata, elliptico-lanceolata vel oblonga, apice caudato-acuminata, basi acuta, 13–18 cm. longa, 3·5–8 cm. lata, utrinque glabra, cystolithis minute striolata, nervis lateralibus utrinque 6–10, valde prorsus curvatis ; petiolus ad 1 cm. longus, glaber. *Inflorescentiæ* interdum etiam ex axillis foliorum rudimentariorum, subsessiles, solitariæ vel plures ex eadem axilla, ob bracteas densissime imbricatas strobiliformes ; bracteæ ovatæ, acutæ, glabræ, 1–1·5 mm. longæ ; pedicelli vix ulli vel ad 3 mm. longi. *Calyx* fere ad basin 5-partitus, 7–9 mm. longus, nigricans, glaber ; segmenta linearia, 0·75–1 mm. lata, etiam in fructu plana, acuminata. *Corolla* ad 17 mm. longa, extus superne parce papillosula ; tubus 12 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum supremum æquans, breviter 3-lobum, lobis lateralibus ovatis, intermedio rotundato latissimo paulo breviore. *Staminum* thecæ æquales, subæqualiter affixæ, oblongæ, obtusæ. *Pollen* 49–53 μ longus, 36–39 μ diametro, plicis accessoriis utrinque singulis, exinio tenuissime punctato. *Capsula* oblonga, subacuminata, in stipitem subæquilongum attenuata, eo incluso circiter 18 mm. longa, glabra. *Semina* 3 mm. longa, minute scrobiculata.

SARAWAK : at the foot of Mount Gading, north of Lundu, *Haviland*, 988 !

16. **H. frutescens**, *Stapf*.

Syn. *Ptyssiglottis frutescens*, Hall. f. in Nov. Act. Nat. Cur. vol. lxx. (1898) p. 222, tab. 16. fig. 2.

CENTRAL BORNEO : Upper Kapuas Basin, on Mount Gagang in high forest, *Hallier*, 2837, 3071 !

WEST BORNEO : on Mount Biang, near the Kapuas River, *Teysmann*, 7920.

17. **H. dispar**, *Stapf*.

Syn. *Ptyssiglottis dispar*, Hall. f. *l. c.* p. 220, tab. 15. fig. 4.

WEST BORNEO : Landak, near Ngabang, *Teysmann*, 11495.

18. **H. granulata**, *Stapf* (sp. nov.).

Herba humilis, procumbens vel e basi prostrata ascendens, sicca viridis, in parte superiore eximie anisophylla. *Caulis* superne villosulo-pubescens,

imprimis in lineis binis e commissuris decurrentibus, inferne glabrescens, viridis, e nodis sæpe radicans. *Folia normalia* petiolata, valde obliqua, elliptica, utrinque obtusa, 5–7·5 cm. longa, 2–3·5 cm. lata, supra glabra vel subglabra, in parenchymate ob cystolithos granulares scabro-punctata, in nervis striolata, in margine subundulato pilosula, subtus in nervis papilloso-furfuracea, nervis lateralibus utrinque 5–7 curvatis ; petiolus 2·5 mm. villosulo-pubescens vel glabrescens ; *folia redacta* inferiora normalibus similia, superiora subsessilia, rotundato-ovata, basi cordata, apice subacuta, 5–8 mm. longa. *Inflorescentiæ* axillares vel specie terminales, breviter pedunculatæ, simplices vel bifurcatæ, ob bracteas dense imbricatas strobiliformes ; pedunculus 2–3 mm. longus ; bracteæ lineari-lanceolatæ, subulato-caudatæ, 5 mm. longæ, herbaceæ, nigrescentes, ad margines parce pilosulæ ; pedicelli ad 4 mm. longi. *Calyx* fere ad basin 5-partitus, ad 5 mm. longus, nigricans ; segmenta lineari-subulata, acuminata, sparse pilosula. *Corolla* 12 mm. longa ; tubus 8 mm. longus ; labium superum late ovatum, emarginatum ; labium inferum supera paululo longius, fere ad medium 3-lobum. *Staminum* thecæ æquales, æqualiter affixæ, basi acutæ, 1·8 mm. longæ. *Pollen* 50 μ longus, 35 μ diametro, plicis polos fere attingentibus, accessoriis nullis, exinio sublævi.

SARAWAK : Lundu, *Haviland's coll.*, 993 !

19. **H. anisophylla**, *Stapf.*

Syn. *Ptyssiglottis anisophylla*, Hall. f. in Ann. Jard. Buitenz. vol. xiii. (1896) p. 289, tab. 23. figs. 2 *a–c*, and in Nov. Act. Nat. Cur. vol. lxx. (1898) p. 219.

WEST BORNEO : Landak, *Teysmann*, 11509.

CENTRAL BORNEO : Upper Kapuas Basin, on Mount Gagang and on the banks of the Saniai Stream on the foot of Mount Amai Ambit, common in shady forest in damp soil, *Hallier*, 3095 ! ; on the Kapuas near Nanga Era *Hallier*.

There are at Kew several more specimens which evidently belong to *Hallieracantha*, but are too incomplete for accurate determination. They include probably one or two distinct species and were collected in Northern Borneo.

General Report upon the Botanical Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904 and 1905. By Dr. A. B. Rendle, F.L.S.

[Read 20th December, 1906.]

The following is an account of the plants collected by Dr. W. A. Cunnington in the three great Central African lakes in 1904–5. The main object of the expedition was the investigation of Lake Tanganyika, which, on one view of its origin and previous connections, might be expected to show in its flora and fauna evidence of a marine affinity.

Dr. Cunnington arrived at Lake Nyasa early in June 1904, and spent about three weeks there; one week at the southern end, a week in ascending the lake, and a week at Karonga at the northern end. He collected, as far as possible in the short time, specimens to illustrate the flora of the lake, including algæ scraped from rocks, and tow-nettings containing diatoms and other plankton. He then crossed the intervening plateau to Lake Tanganyika, the southern end of which he reached early in July. About eight months were spent on and around Lake Tanganyika; the first two months at the southern end, the remainder in cruising about and visiting the most interesting and likely places on the lake-shore. As complete a representation of the flora as possible was collected, including scrapings from the rocks, submerged stems of plants, and tow-nettings made at various places, times, and seasons. Leaving Tanganyika on March 18, 1905, Dr. Cunnington reached Bukoba, on the western shore of the Victoria Nyanza, on April 16. During a stay of ten days here and during a short stay at Entebbe, representatives of the water flora of the lake were collected and a few tow-nettings were taken.

The collections include about 45 species of the larger plants and more than 400 species and varieties of freshwater Algæ, including Peridinieæ.

The seed-plants and fern-plants, numbering respectively 30 and 4, are of no special interest. They include a number of widely distributed aquatics, such as *Najas marina*, *Potamogeton pectinatus*, *P. javanicus*, *Vallisneria spiralis*, *Pistia Stratiotes*, *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Jussiæa repens*, *Trapa bispinosa* and *T. natans*, some of which were not previously recorded from these lakes; and marsh-plants such as *Juncellus lævigatus*, *Fuirena glomerata*, and *Equisetum ramosissimum*. The most interesting from this point of view is *Myriophyllum spicatum*, an almost cosmopolitan water-weed; the genus had not hitherto been recorded from Tropical Africa. Other species found are more or less widely distributed in Tropical Africa: such are *Najas horrida*, *Potamogeton Schweinfurthii*, *Ottelia lancifolia*, several species of *Utricularia*, *Azolla nilotica*, *Pycreus Mundtii*, and *Pæpalanthus Wahlbergii*, the last two being marsh-plants.

A few species, such as *Potamogeton Livingstonei*, only known from Lake Nyasa, *Boottia scabra*, previously found in the Nile and Gazelle Rivers, and now brought from Tanganyika, and *Xyris multicaulis*, a marsh-plant found in swampy ground at Bukoba, Victoria Nyanza, and previously known only from Namasi, in Nyasa-land, have a more restricted distribution.

The only remarkable plant is a new variety of *Fimbristylis stolonifera*, described by the late Mr. C. B. Clarke from swampy ground near the harbour, Bukoba, Victoria Nyanza ; the species has only been previously recorded from India and China (Yunnan).

As shown in the accompanying table (p. 28) (in which two species of *Chara* are included), 16 species were collected at Lake Nyasa, 16 at Victoria Nyanza, and 27 at Lake Tanganyika. The fact that the larger number found at Tanganyika bears a small proportion to the much longer time spent there, suggests that there was not very much more to collect in the way of aquatic seed-plants, ferns, and Characeæ. It is surprising, however, that the margins of the lakes yielded no Lemnaceæ, as several species of *Lemna* and *Wolfia* are recorded from British Central Africa ; nor Alismaceæ, such as *Limnophyton*, known from several localities in Nile-land and the Mozambique district. The characteristic tropical African water-weed *Lagarosiphon* is also unrepresented in the collection ; we may note, however, that a species, *L. Nyassæ*, has previously been described from one of the lakes. Mr. Bennett remarks on the paucity of the number of species of *Potamogeton* found in the margins and bays of these lakes.

A comparison of the aquatic plants (omitting the Algæ) from Lake Tanganyika with those from Lake Nyasa and Victoria Nyanza throws no light on any theory as to a difference of origin or conditions, present or past, in the case of Tanganyika as compared with the other two lakes. The true aquatics which were collected only in Tanganyika are the following :—

(1) *Najas marina*, a cosmopolitan submerged plant which occurs in two of the Norfolk Broads and at other reputed brackish localities, but is also a common freshwater weed, occurring in the Swiss lakes, and plentiful generally in the lakes and rivers of the Continent of Europe.

(2) *Potamogeton pectinatus*, also cosmopolitan and also found in both brackish and fresh water. The leaves are submerged.

(3) *Ottelia lancifolia*, a freshwater species with both submerged and floating leaves; widely distributed in Tropical Africa.

(4) *Boottia scabra*, a freshwater species with submerged leaves; recorded from the Nile and Gazelle Rivers in Central Tropical Africa.

(5) *Nymphæa Lotus*, a water-lily ; recorded from North and Tropical Africa and Madagascar.

(6) *Jussiœa repens*, a floating plant, widely distributed in fresh water in the warmer parts of the whole world.
(7) *Utricularia exoleta*, widely distributed in fresh water in the warmer parts of the whole world ; leaves submerged.
(8) *Chara zeylanica*, a submerged plant common throughout the tropics.

The swamp and marsh plants are also widely distributed and afford no evidence of any peculiarity in the conditions associated with Tanganyika as compared with the other lakes. The freshwater Algæ, on the other hand, have yielded a rich harvest, as ably set forth by Mr. G. S. West. They include representatives of 101 genera and 367 species, of which one genus *Sphinctosiphon*, belonging to the Palmellaceæ, and 34 species are described as new. Mr. Lemmerman, of Bremen, has worked out the Peridinieæ, which comprise representatives of 4 genera and 5 species ; two of the latter are new. The plankton from Tanganyika is of special interest, partly from the fact that no work has been previously done on the plankton from this lake, but especially from the great difference from that of Lake Nyasa and Victoria Nyanza, and the striking marine affinity of some of its constituents. Several of the species are usually marine or brackish in habit, and others more nearly approach marine than freshwater species, indicating in Mr. West's opinion that at one time the lake must have approached marine conditions in the salinity of its water.

The most interesting part of the report is, as I have indicated, Mr. West's account of the freshwater Algæ, which forms an independent paper. In the determination of the higher plants I have to acknowledge the help of Mr. E. G. Baker, Mr. Arthur Bennett, Mr. A. Gepp, Messrs. H. & J. Groves, Dr. Stapf, and the late Mr. C. B. Clarke.

The plants have been presented to the Department of Botany, British Museum, by the Tanganyika Committee through Professor E. Ray Lankester, F.R.S., F.L.S.

DICOTYLEDONS.

POLYGONACEÆ.

Polygonum barbatum, *Linn.* Lake Tanganyika.—From swamp, Kituta, Aug. 24. No. 26.

Widely distributed in the tropics of the Old World.

P. lanigerum, *R. Br.*, var. **africanum**, *Meissn.* Lake Tanganyika.—Marsh close to shore, Komba Bay, Oct. 11. No. 34.

Tropical and South Africa.

P. glabrum, *Willd.* Lake Nyasa.—From swamp, Kota Kota, June 20. No. 6.

Widely distributed in the tropics.

NYMPHÆACEÆ.

(Mr. E. G. Baker.)

Nymphæa ovalifolia, *Conard, Monograph*, 150. Lake Tanganyika.—Swampy pond at Mbete, Sept. 28. No. 31. (In flower.) Lake Nyasa.—Swamp at Kota Kota, June 20. No. 5. Flowers bright blue.

Mr. Drummond, who has paid special attention to this genus, states: "I cannot exactly match these with anything in Herb. Mus. Brit., nor does it recall any specimens at Kew. The forms it seems to approach most closely are *N. ovalifolia*, Conard, and (ex descr.) a specimen of A. von Mechow's, referred but rather doubtfully by Conard to his *N. Heudelotii* type. Pending more material these interesting specimens might be referred to *N. ovalifolia*, Conard."

N. zanzibarensis, *Caspary*. Victoria Nyanza.—Shallow water in river, Bukoba, April 20. No. 52.

Previously recorded only from the Island of Zanzibar.

N. calliantha, *Conard, Monograph*, 151. Victoria Nyanza.—Shallow water in harbour, Bukoba, April 19. No. 49. Flowers pink.

Central and South-west Tropical Africa.

N. Lotus, *Linn*. Forma approaching *N. dentata*, Schum. & Thonn. Lake Tanganyika.—Mouth of Lofu River, Oct. 5. No. 32.

Leaves broadly elliptical, margin remotely undulate-dentate. Differs from the type in the shape and margin of the leaf. In the type the leaves are generally circular in outline and the margin much more distinctly subspinose-dentate. But the anthers are numerous and the connective is absent or very short and obtuse as in the type. Dr. Conard in his Monograph excludes the Indian and American plants which have previously been regarded as belonging to this species.

North and Tropical Africa and Madagascar.

CERATOPHYLLACEÆ.

Ceratophyllum demersum, *Linn*. Lake Nyasa.—In about 4 feet of water, near bar, June 14. No. 3 (small-leaved form). Lake Tanganyika.—In about 4 feet of water, Niamkolo, Aug. 11. Victoria Nyanza.—Surface of weedy lake inlet to north of town, Bukoba, April 24. No. 58. Floating in lake in sheltered bay near Entebbe, May 1. No. 65 (small-leaved form).

Widely distributed in temperate and tropical regions.

HALORAGACEÆ.

Myriophyllum spicatum, *Linn.* LAKE NYASA.—Swamp, Kota Kota, June 20. No. 10. LAKE TANGANYIKA.—Taken shore-wading and in about 4 feet of water, Niamkolo, Aug. Nos. 18, 24.

Almost cosmopolitan, but not hitherto recorded from Tropical Africa, from where the genus also has not hitherto been recorded.

ONAGRACEÆ.

(MR. E. G. BAKER.)

Jussiæa repens, *Linn.* LAKE TANGANYIKA.—Swampy pond at Mbete, Sept. 28. No. 30.

Warmer parts of the whole world.

Trapa bispinosa, *Roxb.* LAKE NYASA.—Floating on surface, Kambwe Lagoon, June 27. No. 13. Flower faint bluish pink. LAKE TANGANYIKA.—Floating on lake at mouth of Malagarasi River, Jan. 16. No. 31. Flower pink.

Tropical Africa and Asia.

T. natans, *Linn.* VICTORIA NYANZA.—Floating on lake in sheltered bay near Entebbe, May 1. No. 64. Also found in the Upper Nile at 2° N. latitude by Speke & Grant.

Central Europe and Temperate Asia.

LENTIBULARIACEÆ.

(DR. OTTO STAPF.)

Utricularia Thonningii, *Schum.* LAKE NYASA.—Surface swamp, Domira Bay, June 19. No. 4. Flower with a pale bluish tinge. LAKE TANGANYIKA.—Mouth of Lofu River, Oct. 5. No. 33.

East and West Tropical Africa.

U. exoleta, *R. Br.* LAKE TANGANYIKA.—Among other water-weeds in shallow water, mouth of Malagarasi River, Jan. 16. No. 611.

Tropical and South Africa, and widely distributed in the warmer parts of the Old World.

U. reflexa, *Oliver.* VICTORIA NYANZA.—Floating on surface of river, Bukoba, April 20. No. 55.

East and West Tropical Africa.

U. stellaris, *Linn.* VICTORIA NYANZA.—Sheltered bay near Entebbe, May 1. No. 620.

East and West Tropical Africa; also in South Africa, Madagascar, India, and Tropical Australia.

COMPOSITÆ.

Spilanthes Acmella, *Linn.* Lake Tanganyika.—Swampy ground near shore, Kibwesi, Dec. 21. No. 40. Flower white.

Common in Tropics.

VERBENACEÆ.

Lippia nodiflora, *Rich.* Lake Tanganyika.—Growing in marsh and swamp, Sumbu, Oct. 19. No. 35. Flower pink.

A common tropical plant.

MONOCOTYLEDONS.

NAIADACEÆ.

Najas marina, *Linn.* Lake Tanganyika.—Dredged in a few fathoms, Niamkolo Bay, Aug. 3. No. 17. A form verging towards var. *muricata,* A. Br.

Var. **muricata,** *A. Br.* Lake Nyasa.—In about 4 feet of water at Kota Kota, June 20. No. 9.

N. marina is a cosmopolitan species with numerous forms and varieties; var. *muricata* is recorded from North Africa (Algiers, Egypt) and Albert Nyanza; and outside Africa, from Sicily, Ceylon, and Australia.

N. horrida, *A. Br.* Victoria Nyanza.—Shallow water in harbour, Bukoba, April 20. No. 50.

Widely distributed in Tropical Africa; recorded from Lake Tanganyika.

POTAMOGETONACEÆ.

(Mr. Arthur Bennett.)

Potamogeton pectinatus, *Linn.* Lake Tanganyika.—Water-weed taken by shore-wading, Mtondwe Bay, Aug. 10. No. 23 (flower).

Cosmopolitan.

P. Livingstonei, *Arth. Bennett.* Lake Nyasa.—In about 4 feet of water, Kambwe Lagoon, June 27. No. 12.

Known only from Lake Nyasa. No fruit has yet been seen.

P. Schweinfurthii, *Arth. Bennett.* Lake Nyasa.—Water-weed growing in about 4 feet of water; south-eastern arm, near anchorage and off Kota Kota, June. Nos. 2 & 8 (flower). Lake Tanganyika.—Growing in shallow water, mouth of Malagarasi River, Jan. 16. No. 45 (flower and unripe fruit). Victoria Nyanza.—From shallow water in harbour, Bukoba, April 21. No. 56 (barren shoot).

These specimens show a greater variation as to leaves and nervation than the original ones; the broadest are 17-nerved, whereas in the original specimens 13 was the largest number of nerves observed.

Confined to East Tropical Africa.

Potamogeton javanicus, *Hassk.* VICTORIA NYANZA.—Shallow water in river, Bukoba, April 20. No. 54 (flower).

Widely distributed in the warmer parts of the Old World and in Tropical and South Africa, but not recorded from Lakes Tanganyika and Nyasa.

The only other *Potamogeton* I have seen from Lake Nyasa is *P. crispus*, Linn., collected by Kirk "In Roangiva (Loangiva?) river." The species is widely distributed in all warm and temperate regions. In these great masses of water it is surprising that around their margins and bays there are so few of this genus. L. Nyasa especially looks like providing them, judging by the large map issued for the Railway.

HYDROCHARIDEÆ.

Ottellia lancifolia, *Rich.* LAKE TANGANYIKA.—Swampy pond, Mshale, Feb. 2. No. 48.

Widely distributed in Tropical Africa.

Boottia scabra, *Ridl.* LAKE TANGANYIKA.—Growing in shallow water, mouth of Malagarasi River, Jan. 16. No. 46.

Previously recorded only from the Central African Nile district (Nile and Gazelle Rivers).

Vallisneria spiralis, *Linn.* LAKE NYASA.—Water-weed growing in about 4 feet of water; south-eastern arm, near anchorage, June 10. No. 1. LAKE TANGANYIKA.—Taken shore-wading, Mtondwe Bay, Aug. 10. No. 21. VICTORIA NYANZA.—Dredged in shallow water in harbour, Bukoba, April 25. No. 59.

Widely distributed in the warm regions of both hemispheres.

Hydrilla verticillata, *Royle,* var. **brevifolia,** *Caspary.* VICTORIA NYANZA.—From shallow water in harbour, Bukoba, April 20. No. 51.

Vegetative shoots only.

The species is widely distributed in the warmer parts of the Old World; the variety is recorded from India and East Tropical Africa.

CYPERACEÆ.

(Mr. C. B. Clarke.)

Kyllinga chrysantha, *K. Schum.* Victoria Nyanza.—From swampy ground close to harbour, Bukoba, April 26. No. 60.

Previously recorded only from German East Africa and the Shiré Highlands (near Zomba).

K. Buchanani, *C. B. Clarke.* Lake Tanganyika.—Swampy ground, Kibwesi, Edith Bay, Dec. 20. No. 39. This specimen differs from all the *K. Buchanani* known to me, in having two spikes to the head, not one, and in having the nut narrowly linear-oblong. There are several admitted species very close.

Nyasaland, and also in South Africa.

Pycreus Mundtii, *Nees.* Lake Nyasa.—From swamp, Kambwe Lagoon, June 27. No. 14. Lake Tanganyika.—From swamp, Kituta, Aug. 24. No. 27.

Frequent from Algiers to the Cape of Good Hope.

Juncellus lævigatus, *C. B. Clarke.* Lake Tanganyika.—Swamp by river mouth, Kirando, Dec. 1. No. 36.

Widely distributed in Tropical Africa, and found in all warm and temperate regions.

Fuirena glomerata, *Lam.* Lake Tanganyika.—Swamp by river mouth, Kirando, Dec. 1. No. 37.

Widely distributed in Tropical Africa, and in the warm parts of the Old World.

Fimbristylis stolonifera, *C. B. Clarke*, var. **africana,** var. nov.; bractea inferiore 9 mm. longa; nucis humeris a squamis rotundis minutis verrucosis.

Victoria Nyanza.—From swampy ground close to harbour, Bukoba, April 26. No. 61.

A remarkable find as the species is known only from India and Yunnan.

There are only two species of *Fimbristylis* (out of about 120) that have a creeping root. As regards the squamellæ on the shoulders of the nut (which are not present in the Indian *F. stolonifera*) I esteem them of small importance; for in the closely allied *F. diphylla*, Vahl, nuts without and with such squamellæ are abundant.

AROIDEÆ.

Pistia Stratiotes, *Linn.* Lake Nyasa.—On surface of swamp, Kota Kota, June 20. No. 11 (in part). Lake Tanganyika.—Floating on lake at Kituta, Aug. 26. No. 29.

Widely distributed in Tropical Africa and in the warmer regions of both hemispheres.

XYRIDACEÆ.

Xyris multicaulis, *N. E. Br.* VICTORIA NYANZA.—From swampy ground close to harbour, Bukoba, April 26. No. 62.

Previously known only from Namasi, Nyasaland.

ERIOCAULACEÆ.

Pæpalanthus Wahlbergii, *Koern.* VICTORIA NYANZA.—From swampy ground close to harbour, Bukoba, April 26. No. 63.

East and West Tropical Africa; also in the Transvaal.

COMMELINACEÆ.

Commelina nudiflora, *Linn.* LAKE TANGANYIKA.—Swamp, Kota Kota, Lake Nyasa, June 20. No. 7. Swamp, Kituta, Aug. 26. No. 28.

A common weed in tropical and warm regions.

PTERIDOPHYTA.

(Mr. A. GEPP.)

Salvinia hastata, *Desv.* LAKE NYASA.—Floating on surface of swamp, Kota Kota, June 26. No. 11 (in part).

Also in Mozambique district and Madagascar.

Azolla pinnata, *R. Br.*, var. **africana,** *Baker.* LAKE TANGANYIKA.—Surface of swampy pond, Mzumbi, Dec. 27. No. 41. Floating on lake, mouth of Malagarasi River, Jan. 16. No. 44. VICTORIA NYANZA.—Floating on surface of river, Bukoba, April 20. No. 53.

Widely spread in Tropical Asia and Africa.

A. nilotica, *Decaisne.* LAKE NYASA.—Floating on surface of swamp, Kota Kota, June 26. No. 11 (in part).

East Tropical Africa.

Equisetum ramosissimum, *Desf.* LAKE TANGANYIKA.—Close to shore, near mouth of Lukuga River, Jan. 4. No. 42.

Warm temperate and tropical zones.

CHARACEÆ.

(Messrs. H. & J. GROVES.)

Chara brachypus, *A. Br.* LAKE NYASA.—Swamp near Karonga, July 2. No. 15. A fairly normal form, in habit resembling large, somewhat connivent forms of *C. fragilis*, Desv.

Recorded in Africa from Suez, Damietta, Kordofan, and Dongola; also specimens in Herb. Kew from Tanganyika Plateau collected by A. Carson.

Known also from India, New Guinea, and North Australia.

Chara zeylanica, *Willd.* (*C. polyphylla*, *C. gymnopus*, &c., A. Br.). LAKE TANGANYIKA.—Niamkoli Bay, Aug. 8. No. 19.

A very small, tufted form of this extremely variable species, in habit resembling small compact *C. aspera.* It does not quite agree with any of the varieties described by A. Braun. It is about 3 in. high, with short, somewhat connivent branchlets; the spine cells are rather numerous, not exceeding in length the diameter of the stem. Branchlets 8–9. Segments about 8, the last 1–2 ecorticate. Bract-cells whorled. Fruit at the 2nd and 3rd nodes, sometimes at the 4th, rarely at the 1st, about ·9–·95 mm. long × ·48 through, showing 11–12 striæ. Nucleus ·62 × ·35, almost cylindrical, black, with well-developed calcareous covering.

No. 22 from Mtondwe Bay, Tanganyika, is a larger state of the same form. It is young and without fruit.

C. zeylanica appears to be the commonest Chara throughout the Tropics. It also occurs northward to the United States and Bermuda, and southward to Australia, New Caledonia, &c.

In Africa it reaches from Egypt southward to Madagascar, and from Angola to Somali-land.

The following Fungi, determined by Mr. V. H. Blackman, were collected on the rotten wood-stays of the canoe on Lake Tanganyika:—*Polystictus sanguineus*, Meyer, a common species in warm countries; a second species of *Polystictus*, the material of which is insufficient for specific determination; and *Schizophyllum commune*, Fr., a cosmopolitan plant.

In the following table I have added a few names of species not collected by Dr. Cunnington. Of true aquatics I find little to add; the number of marsh-plants might probably be still further increased, but these are of less interest.

LIST OF PLANTS FROM THE THREE LAKES.

(Those in *italics* were not collected by Dr. Cunnington.)

	Nyasa.	Victoria Nyanza.	Tanganyika.
Polygonum barbatum	..	..	×
P. lanigerum, *var.* africanum	..	..	×
P. glabrum	×		
Ceratophyllum demersum	×	×	×
Myriophyllum spicatum	×	..	×
Nymphæa ovalifolia	×	..	×
N. zanzibarensis	..	×	
N. calliantha	..	×	
N. Lotus *forma*	..	..	×
Jussiæa repens	..	..	×
Trapa bispinosa	×	..	×
T. natans	..	×	
Utricularia Thonningii	×	..	×
U. exoleta	..	..	×
U. reflexa	..	×	
U. stellaris	..	×	
Spilanthes Acmella	..	..	×
Lippia nodiflora	..	..	×
Najas marina	..	..	×
" *var.* muricata	×		
N. horrida	..	×	×
Potamogeton pectinatus	..	..	×
P. Livingstonei	×		
P. Schweinfurthii	×	×	×
P. javanicus	..	×	
Ottelia lancifolia	..	..	×
O. alismoides	×		
Boottia scabra	..	..	×
Vallisneria spiralis	×	×	×
Hydrilla verticillata	..	×	
Lagarosiphon Nyassæ	×		
Kyllinga chrysantha	..	×	
K. Buchanani	..	..	×
Pycreus Mundtii	×		
Juncellus lævigatus	..	..	×
Fuirena glomerata	..	..	×
F. pachyrrhiza	..	..	×
Fimbristylis stolonifera, *var.* africana	..	×	
Scirpus littoralis	×		
Pistia Stratiotes	×	..	×
Xyris multicaulis	..	×	
Pæpalanthus Wahlbergii	..	×	
Commelina nudiflora	×	..	×
Salvinia hastata	×		
Azolla pinnata, *var.* africana	..	×	×
A. nilotica	×		
Equisetum ramosissimum	..	..	×
Chara brachypus	×		
C. zeylanica	..	..	×
Total	19	16	28

Total Dicotyledons	18
" Monocotyledons	25
" Fern-allies	4
" Characeæ	2
Total	49

On the Origin of Angiosperms. By E. A. NEWELL ARBER, M.A., F.L.S., Trinity College, Cambridge, University Demonstrator in Palæobotany, and JOHN PARKIN, M.A., F.L.S., Trinity College, Cambridge.

(With 4 Text-figures.)

[Read 21st March, 1907.]

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INTRODUCTION.

THE recent progress in our ideas as regards the phylogeny of the Gymnosperms, and more especially of the present day Cycads, led us, in 1903, to begin an enquiry into the origin of Angiosperms. During the last three years we have devoted considerable attention to the living members of this group, for it was thought that the attack could be best begun by taking as broad a survey as

possible of their varied types of fructification, with a view to determining which among them exhibit features that strike us as being of a more or less primitive nature. Having completed this study, we have endeavoured to test the accuracy of our conclusions by an appeal to such evidence as is presented by fossil botany. The result has been that our previously ascertained notions, as to the constitution of the flowers of comparatively primitive members of the group, have been found to agree to a remarkable extent with the facts presented by the fructifications of some, now well-known, Mesozoic fossils. So close is this agreement, that the phylogeny of the Angiosperms in its broad outlines seems to us to be sufficiently clear to permit of the construction of a working hypothesis towards its solution.

It appears to us that although the direct ancestors of the Angiosperms are as yet unknown in the fossil state, this line of descent can now be traced back to the great group of Mesozoic Cycadophyta, and to a hypothetical race of plants nearly related to the Bennettiteæ. There would seem to be good reasons to connect the Cycadophyta themselves with the Fern-like Spermophytes, or Pteridosperms, of the Palæozoic period, and thus the Angiosperms, on our hypothesis, can be derived ultimately from an as yet unknown, fern-like ancestor, existing at a very early geological period.

In this connection the publication of Wieland's full account of the 'American Fossil Cycads' has furnished us with data with regard to the Mesozoic Cycadophyta which, until recently, we did not possess, and to the author of this magnificent volume we would gratefully express our indebtedness for the material which he has placed at our disposal.

We have from the first recognized that what is called the problem of the origin of Angiosperms is in reality a plexus of problems. In addition to the evolution of the flower, there is the puzzling type of Angiospermous foliage, and many other questions to be explained in connection with this group. At the time when we commenced a consideration of this subject, there could hardly be said to be a clue to the mystery in which these matters were shrouded. In presenting this, the first definite hypothesis with regard to the phylogeny of the race, we are aware that many of the main points of our argument are devoid of novelty. Others, notably Hallier, have already brought forward arguments or facts, of which we have made free use in this attempt to fashion our theory.

The subject is a large one, and the present communication is to be regarded as a brief *résumé* of a discussion which we hope to elaborate more completely elsewhere. For the present we have contented ourselves with a statement of the main features of the problem, and its solution, with brief evidence in support of our views.

We would take this opportunity of expressing our sincere thanks to Dr. D. H. Scott, F.R.S., for many suggestions during the past three years, and for the interest he has taken in the progress of the work.

HISTORICAL.

The great race of plants, commonly referred to as the "Flowering Plants," differ so obviously from the rest of the Vegetable Kingdom, that they were recognized, comparatively early in the history of botanical study, as forming a distinct group, and for a long time attention was almost entirely concentrated on them.

The stamens and carpels were soon identified as the male and female organs respectively, and by the close of the 17th century Camerarius had shown that reproduction by means of seeds depends on the male element, the pollen, reaching the receptive part, or stigma, of the female organ; though what exactly happens in the process of fertilization remained mere guesswork until many years later. This establishment of the sexual theory of reproduction in Flowering Plants led to the subdivision of the Vegetable Kingdom, by Brongniart in 1843, into two great groups, the Phanerogams and the Cryptogams, the latter still being incorrectly regarded as devoid of sex, and as possessing a 'cryptic' type of reproduction.

The researches of Robert Brown led to the distinction of Gymnosperms as opposed to Angiosperms, though for many years the former were commonly looked upon as a detached group or appendage of the Dicotyledons, with the consequence that the terminology of the *flower* came to be applied to their very different kind of fructification. Hofmeister's classical researches, published in the years 1849 and 1851, completely broke down the barrier separating the Phanerogams from the Cryptogams; in fact these terms were no longer applicable in their original sense, for their meaning had become reversed, since the Flowering Plant was found to be more 'cryptogamic' as regards its manner of sexual reproduction than the Fern. The alternation of generations, so clear in the Pteridophytes, was shown to be also present in both Gymnosperms and Angiosperms. The male and female prothalli of the heterosporous Vascular Cryptogams had their very reduced representatives in the pollen-grain and embryo-sac respectively of the Phanerogams.

These discoveries, followed so closely by the publication of Darwin's 'Origin of Species,' gave a great impetus to the evolutionary hypothesis as applied to plants, and a great stimulus to phylogenetic speculations.

Though the various parts of the embryo-sac of the Conifer could be interpreted in terms of the female prothallus of a heterosporous Pteridophyte, investigations of the corresponding organ of the true Flowering Plant (either Monocotyledon or Dicotyledon) failed to show any such clear homologies. In other words the gap that originally existed between the Phanerogams and Vascular Cryptogams was now bridged, and in its place there appeared a wide gulf between the Conifers and true Flowering Plants, or more exactly between the Gymnosperms as a whole and the Angiosperms.

The subsequent tendency of various lines of research, until quite recently, has been on the one hand to draw closer together the ties of relationship existing between Gymnosperms and Pteridophytes, and on the other hand to increase the isolation of the Angiosperms. For instance, one of the most important embryological facts, recently brought to light, linking together the Gymnosperms and the Pteridophytes, is the formation of antherozoids in the pollen-tubes of *Cycas* and *Ginkgo*.

Much work has been done on the embryo-sac of Angiosperms, primarily with the hope of throwing light on the question of its homologies, and the line of descent of the group. Practically every Angiospermous family, which is of interest phylogenetically, has now been examined, including quite recently the Magnoliaceæ *. The outcome of the whole of this vast investigation has merely emphasized the great difference which exists between the Angiospermous and Gymnospermous embryo-sacs, and in addition the great similarity between those of the Dicotyledons and the Monocotyledons. Variations do occur, but these appear to us to be points of detail rather than of fundamental importance. In fact they are of such a kind that it is uncertain whether they should be best regarded as primitive or as recently acquired. This is particularly true of the antipodals, a group of cells more variable perhaps than any of the other constituents of the embryo-sac. Though the net result of these studies has so far not enabled us to bridge the gap between the Angiospermous and Gymnospermous embryo-sacs, yet additional discoveries of great interest have been made, *e.g.* double fertilization and chalazogamy. The former seems to increase rather than to diminish the difficulty of explaining the Angiospermous embryo-sac and especially its endosperm in terms of the fern-prothallus, or the female gametophyte of the Gymnosperm.

Turning now to palæobotanical work, the main result has been the same. Remarkable fossils have been found connecting the Gymnosperms more closely with the Ferns, but anything of a like nature bearing on the Angiosperms has remained hidden. The rocks have been singularly silent as regards the origin of the latter group, now predominant in the vegetation of the world.

The existing Cycads, and less clearly the Conifers, have been linked up with the Ferns by means of the anatomical investigations of certain Palæozoic petrified stems possessing fern-like characters, known as the Cycadofilices, and by the discovery of the seeds and male fronds of these plants. The old idea of connecting the Gymnosperms with the Lycopods is now no longer tenable, at any rate so far as the Cycads are concerned. The Angiosperms, on the other hand, have been considered to have sprung from the Ferns; yet no work on the existing Filices has shown any direct connection between the two groups. It is true that *Isoetes* † has been brought forward as revealing in the mode of origin of its stem, root, and first leaf, as well as in its adult

* Strasburger (1905).

† Campbell (1891) pp. 253–254.

vegetative features, points of close resemblance to certain Monocotyledons, but to build a relationship upon such slight evidence appears to us hardly worthy of serious consideration. In fact Campbell himself says * : "There is, howeve an immense interval between the flower of the simplest angiosperm and the porophylls of *Isoetes*, and it would be rash to assume a relationship unless mo evidence can be produced on the side of the angiosperms to warrant this.

It is genera held that when we first meet with fossil Angiosperms in the Mesozoic rocks, th leaf-impressions closely resemble those of existing genera. Whence they spra has hitherto remained a complete mystery.

Saporta and M ion †, some twenty years ago, in their work entitled L'Évolution du R gne végétal,' brought into use the term Proangiosperms for a hypothetical group of extinct plants which gave rise to the modern Monocotyledons a Dicotyledons. They went even further, and included such fossils as *Will msonia* among the members of this group. These suggestions we think ere particularly happy, considering the material then at their disposal. I the main palæobotanical science at the present time supports them.

A brief referenc must be made to the supposed connection between the Angiosperms and he Gnetaceæ. Of all the existing Gymnosperms, this particular group h long been considered to show the largest number of features in commo with the true Flowering Plants. Attempts, however, to establish a clear rel tionship have not met with much success.

Lotsy ‡, from a embryological study of *Gnetum*, came to the following conclusions. The oup appears to be of very ancient origin, it probably arose independently of e other Gymnosperms direct from the heterosporous Pteridophytes, and, moreover, has not given rise to any single Angiosperm.

Lignier §, more ecently, from a general examination of the Gnetacean fructifications, also ecides against any direct relationship. He says that such a complex infloresc ce as that possessed by the Gnetaceæ cannot be held to show any affinity b ween this group and the simplest Angiospermous flower. Hence he conclud that the Gnetaceæ are not intermediate between the Gymnosperms and ngiosperms.

Miss Benson ‖, n the other hand, since the publication of these two memoirs, has ende oured to bring the floral morphology of this group into line with that of he Angiosperm. She suggests that the suppression of the internodes in e inflorescence of *Gnetum* may have been carried still further, so that th whole is reduced to a conical torus, that is to a structure resembling the re eptacle of a flower like *Liriodendron*. This seems a complicated, and rdly justifiable hypothesis, for there is no evidence to

* (190 p. 254. † Saporta & Marion (1885).
‡ Lot (1899). § Lignier (1903[2]).
‖ Ben (1904).

show that such simple flowers as those possessed by the Magnoliaceæ are in reality compound structures, *i. e.*, very compressed inflorescences. Everything points in the other direction, namely that the sporophylls (stamens and carpels) are borne directly on the main axis of the floral shoot.

Hallier *, quite recently, has suggested a possible connection between the Gnetaceæ and the Loranthaceæ. Though agreeing in the main with his phylogenetic views respecting the Flowering Plants as a whole, we are inclined to regard this as a somewhat rash, though ingenious speculation; especially because it necessitates, as he admits, the nucellus of *Gnetum* being regarded, not as a single ovule, but as a placenta bearing several ovules.

Finally, then, we may conclude that the study of the Gnetaceæ does not, and does not seem likely to, help us in understanding the phylogeny of existing Angiosperms. It would appear more probable that a knowledge of the descent of the latter, obtained from other sources, will itself shed light on the relationships of the former.

From a discussion on the vascular structure of seedlings, at the last meeting of the British Association at York †, the inference may be drawn that some help will be forthcoming from this line of study towards solving the problem of the origin of the Angiosperms. So far, the examination of the "transition" phenomena in seedlings has led Mr. Tansley and Miss Thomas to regard the simple type met with in the Dicotyledons, and most of the Coniferæ, as derived by reduction from the more complicated one found in the Cycads and the Araucarieæ.

Thus, by way of summary, it may be said that no definite theory, as regards the origin of the Angiosperms, has up to the present been elaborated. The views put forward from time to time have been more of the nature of casual suggestions. The problem has not yet been separately treated as a whole, in all its bearings. The morphologist has perhaps hitherto inclined only to a comparison between living members of the race, with neglect of the fossil evidence. The palæobotanist, in approaching the subject, does not appear to have arrived at any clear conception of what may be considered the primitive features of living Angiosperms.

In concluding this section of the paper, it is interesting to note that this unsolved problem has its parallel in the Animal Kingdom. The origin of the highest group, the Mammalia, still remains largely problematical.

PRINCIPLES OF EVOLUTION.

Before discussing what we regard as the primitive forms of the various organs of the Angiospermeæ, we would emphasize briefly certain principles connected with evolution to which we attach considerable importance when attempting to trace the phylogeny of living or extinct races.

* Hallier (1905). † Anonymous (1906) p. 182.

The Law of Corresponding Stages in Evolution.

If we study the stages in evolution reached by the different organs of a seed-plant at any one period, we shall find that they are dissimilar. Some are obviously more highly evolved than others. Corresponding stages in the evolution of the various members of a seed-plant are not contemporaneous in point of time. Conversely, at any one period in geological time, one organ or set of organs will be found to have reached a far higher stage of evolution than another.

The study of fossil botany has afforded numerous instances of the truth of this principle. The foliage of the Pteridospermeæ, as also the habit of the stem, is essentially fern-like, though the female organ is a seed. The male organs (*Crossotheca*) of *Lyginodendron* are obviously far less highly evolved than the female (*Lagenostoma*). The former is essentially a simple fern-like fructification, the latter a highly evolved seed.

Or, again, to turn to the Bennettiteæ, the Mesozoic descendants of the Pteridospermeæ, the microsporophylls are still essentially fern-like fronds, while the megasporophylls are of an extremely advanced type. The trunk habit of these plants also shows scarcely any modification as compared with that of a Palæozoic tree-fern.

Or to turn to recent plants. The fern-like foliage of the Cycad *Stangeria* is associated with highly-evolved strobili. Again, the female sporophyll of *Cycas* is more primitive than the male, and its fern-like origin is still traceable.

Other instances might be quoted *, but the above may suffice. It follows from this law that there was never in existence such a plant as a really primitive Angiosperm, in the sense that all its organs were equally of a primitive nature. On the contrary, the earliest Angiosperms were no doubt characterised by possessing some members much more highly evolved than others. There is reason to believe that the Angiosperms were derived from other seed-plants, but that the seed, in itself a highly evolved structure, originated at a much more remote period.

We believe that the application of this principle will be found to be of great service in such considerations as the present. At a later stage (p. 70) we propose to demonstrate by its aid the probability that the earlier Angiosperms still retained the megaphyllous foliage of their ancestors; a supposition which will explain several puzzling facts.

Homoplasy.

It is well recognised that one of the great difficulties to be faced in attempting to trace the phylogeny of living groups lies in the tendency to error, arising from laying stress on certain features as indicative of close

* See Wieland (1906) p. 244, who has also discussed this law.

relationship, which are more probably simple expressions of parallelism of development. Sometimes the issue is so obscured by numerous instances of homoplasy, that it is difficult to arrive at any sure conclusion. The broad question of the phylogeny of Angiosperms, however, seems to us to be remarkably free from embarrassment in this respect.

Mutation.

While we regard the course of evolution as for the most part a slow and gradual process of variation, we are prepared to admit that, now and again, abrupt and discontinuous phases * occur. The same conclusion holds in regard to theories connected with inorganic evolution. Catastrophism has been replaced by uniformitarianism, which in turn is succeeded by a theory, which admits that, at certain periods, the forces of nature may have been working at a greater intensity than they are to-day.

There is a bare possibility that mutation may have been concerned with the evolution of the Angiosperms themselves, for the suddenness with which this group rises to the position of a dominant type in the flora of the Cretaceous and Tertiary periods is perhaps difficult to explain on any other hypothesis, unless we accept the theory of the imperfection of the geological record in this instance.

One of the great difficulties which arises from our still highly imperfect knowledge of the Mesozoic floras is that at present, in the great majority of instances, we are familiar only with the foliage of these plants. Among such leaf impressions, the absence of any conspicuous intermediate forms combining features common to the Angiosperms and any other group is remarkable, and this evidence, though not perhaps of great importance, may admit the possibility of mutation rather than of gradual variation (see p. 71). On the other hand, too free a use of this principle is not to be favoured, else there is a distinct danger that mutation may become the last resort of the phylogenetically destitute.

PRIMITIVE FEATURES AMONG LIVING ANGIOSPERMS.

THE STROBILUS THEORY OF THE ANGIOSPERMOUS FRUCTIFICATION.

The basis of our theory as to the nature of a typical Angiospermous flower is that such a fructification consists essentially of a strobilus or cone †. We regard the simpler, unisexual flowers, including apetalous forms, as derived from a amphisporangiate ‡ strobilus by reduction. The term "flower" has

* De Vries (1901, 1905).

† Coulter & Chamberlain (1904) p. 9.

‡ The terms "bisporangiate" and "ambisporangiate" have been used by Wieland and other authors. We regard these terms as open to objection, and propose to adopt "amphisporangiate" in their place, as the antithesis of "monosporangiate."

been used in a great variety of senses *. We would, however, restrict its application to the Angiosperms alone, since it was from these plants that the idea expressed by the word originally arose. In our opinion extra-seminal pollination, in which the carpel or carpels play the chief part in the pollen collection, is the essential feature of a hermaphrodite, or female flower. We regard a flower as typical when it possesses both micro- and megasporangia, as well as a perianth which in many cases has an attractive function.

A flower, on our view, is a *special form* of a type of strobilus, which is common both to the Angiosperms and to certain Mesozoic plants, and which may be termed an *anthostrobilus*. The anthostrobilus of hypothetical Mesozoic ancestors of the Angiosperms, and of their supposed near relatives the Bennettiteæ, differed from the flower of the Angiosperm in certain important respects, especially in the presence of direct pollination, in which the megasporophyll played no part. It may perhaps be useful to distinguish it as a *Pro-anthostrobilus*, and the Flower proper, a term here restricted, as an *Eu-anthostrobilus*.

Anthostrobilus { Pro-anthostrobilus of Mesozoic Ancestors and Bennettiteæ.
Eu-anthostrobilus (Flower) of Angiospermeæ.

The necessity for these new terms arises from the fact that the word "flower" has been applied in many different senses, for instance even to the strobili of the Coniferales. Also because, as we hope to show here, the Angiosperms are descended from Mesozoic ancestors nearly related to a group of fossil plants, whose fructification is now well known, and indeed has been, though as we think inaccurately, termed a flower.

We shall discuss at some length at a later stage the evidence for the derivation of the Eu-anthostrobilus from the Pro-anthostrobilus—types of cones which we believe represent different stages in the evolution of the fructification of one and the same line of descent.

The strobilus or cone is of course a very ancient type of fructification, common to many distinct, and only very remotely related lines of descent. Other forms of strobili were borne by plants which flourished at a very much earlier period in geological time than the anthostrobilate races discussed here. The anthostrobilus is distinct from any of these, and it is, in all probability, the newest modification or creation of the strobilate form of fructification, in point of geological time. It differs from all other strobili in that it is typically amphisporangiate, by the megasporophylls being invariably aggregated on the axis of the strobilus above the microsporophylls (*i. e.* nearer the apex of the cone), and by the presence of a distinct perianth, below the fertile sporophylls, whose function is apparently wholly, or partly, of a protective nature. In

* Coulter & Chamberlain (1904) p. 9.

other words, the protective office, which in the strobili of many Pteridophyta is performed by the aggregate of the fertile sporophylls themselves, is, in the anthostrobilus, localised towards the base of the cone, and performed by sterile members. In order to bring out more clearly the essential features of the anthostrobilus, we may compare it briefly with a heterosporous cone of an ancient type, such as that of *Lepidodendron Hibbertianus*, Binney *, from the Lower Carboniferous of Scotland.

	L. Hibbertianus, Binn.	*Anthostrobilus.*
Elongated axis	cylindrical.	more or less conical.
Megasporophylls situated	basally as regards the microsporophylls.	apically as regards the microsporophylls.
Protective function performed by	distal extremities of both types of fertile sporophylls.	sterile, basal, leaf-like organs.

Engler's Theory.

The Strobilus Theory of the nature of the typical Angiospermous flower is not by any means a new one †, though it differs *in toto* from that generally accepted by systematists at the present time. According to current notions, widely but not universally adhered to, the primitive type of Angiospermous fructification is to be sought for among the unisexual Apetalæ, which, on our view, are forms reduced from amphisporangiate strobili, in each case possessing a perianth.

This prevailing opinion, for which Engler ‡ is largely responsible, has been too readily accepted § as a self-apparent axiom, before careful examination of its truth has been made.

In a recent authoritative discussion of this question, Coulter and Chamberlain ‖ state that as a consequence of the now "discarded doctrine of metamorphosis . . . . it has been a very prevalent conception, therefore, that flowers of simpler structure than the assumed type are reduced forms. There are certain cases in which this seems clear . . . . but the vast majority of simpler flowers are better regarded as primitive than as reduced forms."

On the other hand there have not been wanting others ¶, especially Hallier **,

* See Scott (1900) p. 162, fig. 65.
† Coulter & Chamberlain (1904) pp. 9 & 10.
‡ Engler (1897) p. 358. § Chamberlain (1897).
‖ Coulter & Chamberlain (1904) p. 10.
¶ Henslow (1893[1]) p. 485; Čelakovský (1897).
** Hallier (1901[1], 1901[2], 1903, 1905).

who have already upheld the view maintained here. Goebel *, in particular, regards the amphisporangiate condition as primitive, and the monosporangiate as derived from it.

It will be necessary here to examine somewhat at length the evidence for the assumption that certain naked flowers may be regarded as primitive, and the consequent corollary that their near relatives, with insignificant perianth, are derived from them.

The main departure of Engler's and Eichler's systems of classification from that of Bentham and Hooker consists in the abolition of the large group Monochlamydeæ or Incompletæ, and the distribution of its families among the Polypetalæ, making one large series, the Archichlamydeæ or Choripetalæ ; without question a move in the right direction. At the same time both Engler and Eichler cease to regard the Ranales (Polycarpicæ) as the starting point of existing Dicotyledons. They commence their systems with plants possessing flowers composed of few parts, especially the Piperaceæ and its near allies, and also with the Amentiferous families. Their scheme of classification then gradually advances from plants with naked flowers to others possessing an insignificant sepaloid perianth, and finally to such orders as the Caryophyllaceæ with a well-marked calyx and a conspicuous corolla. From this point of view, the gradual evolution and differentiation of a perianth can be traced in a general way.

Three objections of considerable weight can be advanced against this theory. In the first place, it must be assumed that the perianth is evolved *de novo*, and is an organ *sui generis*. Secondly, in many of the groups regarded as primitive, *e.g.*, Piperales, Amentiferæ, and Pandanales, the inflorescence is a sharply defined and often a highly complicated structure. Lastly, such a theory has so far proved barren from a phylogenetic standpoint, especially when the attempt is made to bring into line evidence derived from the study of fossil plants.

We may now briefly examine the cohorts which Engler regards as showing primitive features.

Piperales.

This cohort is placed first in Engler and Prantl's system, and includes four orders, of which only the Piperaceæ is well represented by the species of two genera *Piper* and *Peperomia*. A survey of its members suggests that its flowers are fashioned, for the most part, on the trimerous plan, with two whorls of stamens and three carpels. No one would argue that a species of *Piper* with only two stamens has preceded one with six, nor that one with three carpels has been derived from an ancestor with a single carpel. Nor is it to be supposed that a genus like *Chloranthus*, with a single tepal, has given rise to one

* Goebel (1905) p. 528.

like *Lacistema*, with a complete perianth whorl. It is much more natural to suppose that the other members of the whorl have been aborted, and that such genera as *Piper* and *Peperomia* have been evolved by further reduction, during which the perianth has disappeared altogether. In the monotypic genus *Lactoris*, placed by Engler in the Ranales, but by Bentham and Hooker, among others, in the Piperaceæ, can be found a synthetic type linking these two cohorts together *.

Thus, in our opinion, the more obvious and plausible view is that the Piperales branched off, probably at an early period, from the Ranales, and, as in the case of many other Angiosperms, have suffered considerable reduction in the individual flower, so much so that in many instances they have lost their perianth. This line of evolution appears to have progressed side by side with a tendency to aggregate the flowers into dense spikes; the bracts assuming more and more the functions originally performed by the perianth. In a few of the Piperales the grouping of the flowers has advanced a stage further. In the Peppers of the section *Potomorpha* the spikes are arranged in umbels. Such compound inflorescences surely are hardly characteristic of "plants of low organisation" †.

Both the recent studies of the seed-development of the Piperales by Johnson ‡, and of the seedling-structure by T. G. Hill §, have led these authors to conclude that this is not to be regarded as a primitive cohort.

Amentiferæ.

The term Amentiferæ is used here, for the sake of convenience, to include those families of trees characterized by unisexual flowers—or at least the male flowers—crowded together into very dense and definite inflorescences known as catkins; a type of inflorescence which is shed entire, and thus functions largely as a single flower. In some families, *e.g.*, those included in Engler's cohort Fagales, the catkin is of a highly complex and compressed nature—a feature hardly suggestive of primitiveness, but rather of a reduction in the component parts. In such, a suppression of the perianth might naturally be expected.

Salicaceæ.—This family consists of two genera only, *Salix* and *Populus*, the one entomophilous, the other anemophilous. Divergency of opinion exists as to whether the entomophilous habit of *Salix*—an almost unique occurrence amongst the Amentiferæ — is to be regarded as a primitive feature, or one derived from a Poplar-like ancestor by a change in the method of pollination.

Chamberlain ‖, from an embryological study, concluded that the genus

* Hallier (1901[2]). † Willis (1904) p. 515. ‡ Johnson (1905).
§ Hill, T. G. (1906). ‖ Chamberlain (1897).

Salix is primitively unisexual, diœcious, and naked. Robertson *, on general grounds, considers *Populus* the more recent genus.

On the other hand, the opposite view has been maintained, and has quite recently received strong support from Haines' † descriptions of two new species of Indian Poplars. One of these, *Populus glauca*, Haines, frequently possesses hermaphrodite flowers with an undoubted perianth.

To us it appears to be the more reasonable view to regard *Populus* as the older genus, and *Salix* as derived from a Poplar-like ancestor at a more recent period. On this view, *Populus glauca* has retained more primitive features than the other species, and thus departs less from the ancestral type, while the entomophily of *Salix* is but a recently acquired character. It also implies the derivation of a flower such as that of *Salix*, which has only two stamens and never more than two carpels, by reduction from a plant like *Populus*, possessing many stamens and sometimes more than two carpels. At the same time, we regard *Populus* itself as not primitively anemophilous, but derived originally, with the other Amentiferous families, from entomophilous ancestors.

Another fact to be taken into consideration in this connection is that, at the present day, the genus *Salix* is largely represented by species, whereas *Populus* contains comparatively few. The former thus appears to be a plastic up-grade type, as is further emphasized by the ill-defined nature of many of its species. The re-adoption of entomophily has possibly been the saving of the Willows.

Casuarina.—For those who uphold the view that some of the present day Angiosperms without perianth are primitively naked, this genus has been perhaps the most promising. In several features it strongly suggests the retention of archaic structures. Attempts have been made to separate it entirely from the rest of the Dicotyledons. Treub's ‡ suggestion, based on the initial discovery of chalazogamy, broke down when the fact was ascertained that many of the Amentiferæ, as well as other groups, also exhibit this mode of fertilization. On the other hand, Engler § regards *Casuarina*, which he places in a new cohort Verticillatæ, as the most primitive of Dicotyledons, from the fact that many megaspores are found within the nucellus. In the light, however, of recent research this conclusion is by no means justified, for Chamberlain ‖ finds that more than one megaspore occasionally occurs in *Salix*. Still more recently Shoemaker ¶ has shown that in *Hamamelis* several megaspores are found. Frye's ** study of the embryo-sac of this genus has demonstrated that it is quite of the usual type, and does not differ as regards

* Robertson (1904). † Haines (1906).
‡ Treub (1891). § Engler (1897) p. 362. ‖ Chamberlain (1897).
¶ Shoemaker (1905); see also Coulter & Chamberlain (1904) p. 242.
** Frye (1903).

the presence of antipodals, or the time of endosperm formation, from that of other Dicotyledons, as Treub supposed. It has been further suggested, within the last year, on embryological evidence, that *Casuarina* is closely related to *Carpinus*, and may be placed within the Betulaceæ as a group of equivalent rank with the Coryleæ *.

Consequently, on such arguments as have been brought forward, we fail to find conclusive evidence that the flower of *Casuarina* is essentially of a primitive nature. Nor does the position of the group now appear to be isolated.

Fagales.—The perianth of the female flower, when present, is superior and somewhat gamophyllous. These are not likely to be the characters of a primitive perianth. Besides, the syncarpous inferior ovary does away with any idea of primitiveness as regards the whole flower. The inflorescence is also especially complicated. Similar considerations apply equally to the Juglandales.

We are inclined to adopt Hallier's † view, that this group can be connected with the Hamamelidaceæ, and thus with ancestors possessing hermaphrodite flowers and biseriate perianths. On this supposition, the perianth of the Fagales may probably be regarded as a survival of the calyx, the corolla having disappeared completely.

Monocotyledons.

Among the Monocotyledons we find certain genera which may very possibly be ancient types, without, or with a only very insignificant perianth. Hence the question arises whether these plants were originally without such an envelope.

Pandanales.—To this group, regarded as among the most primitive by Engler ‡, and also by Coulter and Chamberlain §, we think the same arguments apply as in the case of the Piperales and Amentiferous families. The inflorescence is of a very dense and sharply defined nature. In the Pandanaceæ the individual flowers are difficult to make out, bracts and bracteoles being absent. It seems much more probable that in this case the perianth of the individual flowers, as well as the bracts and bracteoles of the inflorescence, have totally disappeared, and the internodes of the floral axis become greatly reduced, with the result that the individual flowers, especially the male, have become so merged together that they can hardly be distinguished from one another. Consequently we are inclined to think that the Pandanaceæ branched off at some early period from the main line of the Monocotyledonous descent, and are thus capable of being derived from an ancestor with hermaphrodite flowers and a well-developed perianth.

Araceæ.—In the interpretation of the Araceous flower we are in general agreement with Engler. He regards those members of the family with few

* Benson, Sanday & Berridge (1906) p. 43.

† Hallier (1903).

‡ Engler (1897) p. 360.

§ Coulter & Chamberlain (1904) p. 228.

floral parts as reduced. Here the gradation from hermaphrodite flowers with a complete perianth to unisexual naked types presents all stages of reduction. At the same time we can trace the evolution of a complicated inflorescence. The attractive function of the perianth in a less highly evolved genus, such as *Acorus*, is transferred in many of the higher members to the spathe, which may become petaloid and envelop the whole inflorescence. In fact the inflorescence practically comes to function as a single flower.

Here we find our opponents adopting the very views which we, in common with Hallier and others, urge as applicable to all such cases where naked flowers are aggregated in dense inflorescences. If *Acorus* and its near allies were non-existent, would this interpretation of the family have met with equal acceptance? Because these stages cannot be so easily traced in other groups such as the Piperales and Amentiferæ, the absence of a perianth in these flowers has been too readily accepted as a primitive feature.

Though Engler regards the hermaphrodite flowers of a genus like *Acorus* as the most primitive types in the order, Campbell *, on the other hand, has decided that the unisexual flower, with a single carpel and a solitary basal ovule, e. g., *Spathicarpa*, *Aglaonema*, and *Nephthytis*, is really the least highly evolved. This conclusion, based on embryological considerations, appears to us to rest on far too slender evidence, especially in view of the fact that no general agreement exists as to which features presented by a study of the embryo-sac may be regarded as primitive.

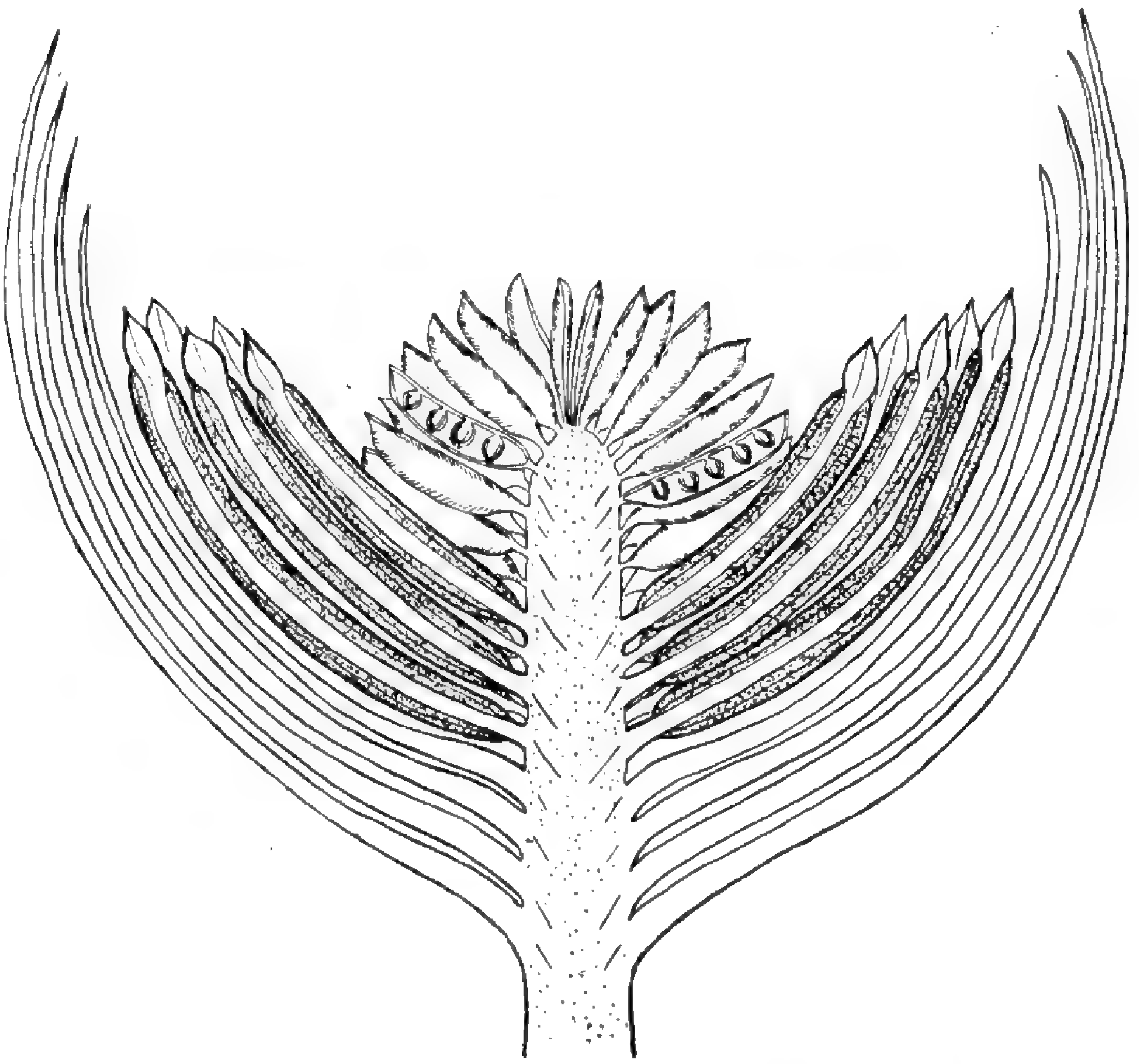
The Primitive Form of the Organs of the Eu-anthostrobilus or Flower.

We have seen that Engler and others regard certain orders, where the flowers are devoid of perianth and often unisexual, as the more primitive members of both existing Dicotyledons and Monocotyledons. But it must not be overlooked that Engler's Theory, like the Strobilus Theory discussed here, is but a working hypothesis, the truth of which is to be sought for in its application. The, at present, prevailing view has the merit of simplicity. We start with something simple, and from it derive the more complicated types of flowers, possessing a biseriate perianth, and at the same time the hermaphrodite or amphisporangiate condition. But its application as a working hypothesis does not assist us in our search for a clue to the phylogeny of the Angiosperms as a whole. Nor does it help to bring this group into line with any of those now known to us in the fossil state. On the other hand, the Strobilus Theory, which postulates that the monosporangiate Apetalæ were derived by reduction from an amphisporangiate strobilus possessing a distinct perianth, leads us back naturally to a great group of Mesozoic plants, the Bennettiteæ, which afford the key to the ancestry of the race in question.

* Campbell (1905).

In trying to arrive at some conclusion with regard to the primitive form of the various organs of the Angiospermous strobilus, we have found it helpful to endeavour to conceive a mental picture of a flower in which all the members were alike primitive. We, however, by no means wish to infer that such a flower ever existed, for, as we have pointed out above (p. 35), this would be contrary to the general trend of evolution, since corresponding stages in the differentiation of the various organs of a seed-plant, at any one point of time, are

Fig. 1.



An Angiospermous strobilus or flower in which the perianth, microsporophylls and megasporophylls, two of the latter being shown in longitudinal section, are represented as if in the primitive condition. This cone is entirely imaginary, and in all probability never existed.

dissimilar. Such a strobilus (see fig. 1) would consist of a large, elongated, conical axis bearing megasporophylls above and microsporophylls below. At the base of the cone, a well marked perianth would be found, consisting of sterile, leaf-like members, affording protection to the cone as a whole, and playing some part in the mechanism for insuring cross-fertilisation by adding to its conspicuousness. All the organs of the cone would be of large size, numerous or indefinite in number, and spirally arranged. The cone would be solitary, borne either terminally or axillary.

The gynæceum would consist of an indefinite number of carpels forming apocarpous, monocarpellary ovaries, each containing several ovules, with marginal placentation. There would be no style. The stigmatic surface would be more or less confined to the apex of the carpel, and would probably be of a sticky nature, or the apex of the carpel may have remained slightly open, as in the modern *Reseda*. The ovule would be orthotropous, with two integuments. The carpel would dehisce by the ventral suture, and the seeds be distributed by simply falling from the carpel, or being shaken out of it by the wind. The embryo would germinate within a short period after fertilisation, and would possess two epigeal cotyledons.

The andrœcium would comprise an indefinite number of stamens, with long anthers. The filaments would be short, and the connective produced beyond the anther as a slight expansion.

The perianth would consist of numerous, spirally arranged members, either all similar in form, colour, etc., or somewhat differentiated, with an inner petaloid series serving both as an attractive and protective organ.

The mode of fertilisation would be by means of entomophily, the pollen-collecting mechanism being performed by the carpels.

It will thus be seen that we regard polypetaly, hypogyny, and apocarpy * as primitive conditions, antecedent in point of time to the more highly evolved states, in which cohesion and adhesion of similar or dissimilar organs is to be found.

As we have pointed out, there is no reason to believe that any Angiosperm with a complete assemblage of primitive floral characters is to be found to-day, nor indeed that such a flower ever existed. On the other hand, there are many Angiospermous flowers which retain one or more primitive features. According to our view, the greatest number are exhibited in the families Magnoliaceæ, Ranunculaceæ, Nymphæaceæ and Calycanthaceæ, amongst Dicotyledons; and Alismaceæ, Butomaceæ and Palmaceæ, among Monocotyledons.

Magnoliaceæ.

In this family we find an elongated receptacle, bearing an indefinite number of stamens and carpels, which are spirally arranged. The form of the stamen, with its long and broad connective, continued below as a very short filament and above as a sterile apex, is also a primitive feature. The perianth of the members of the two tribes Schizandreæ and Illicieæ consists of many tepals, spirally arranged. In the tribe Magnolieæ however, it is cyclic, and sometimes in three definite whorls; a stage obviously derived from the preceding. In the allied Anonaceæ this arrangement is generally characteristic.

* See also Bessey (1897).

Certain members of this alliance also retain a primitive feature in the homoxylous character of the wood, e. g., *Drimys*, *Tetracentron*, and *Trochodendron* *. This family has already been instanced by Hallier † and others as showing a comparatively large number of primitive characters. The recent study by Strasburger ‡ of the embryo-sac of *Drimys* has shown, however, that it practically does not depart from the stereotyped form common to nearly all Angiosperms.

Ranunculaceæ.

Some members of this family present primitive features in the form of the receptacle and perianth, as well as in the fact that the numerous stamens and carpels are spirally arranged. The perianth of this group is also in many cases of a primitive nature, though often petaloid and sometimes clearly differentiated into calyx and corolla. In addition, honey-leaves, the homologues of fertile microsporophylls, may be present.

Nymphæaceæ.

In the members of this family, especially in the genus *Nelumbium*, we find numerous stamens of a similar form to those of the Magnoliaceæ, as well as certain features in connection with the perianth, which we regard as fairly primitive.

Calycanthaceæ.

The numerous, spirally arranged stamens and carpels, and the large number of perianth members may be regarded as primitive features.

Monocotyledons.

Alismaceæ and Butomaceæ.

In some members of these closely-allied families the stamens are indefinite in number, and the carpels numerous and apocarpous, features which, from our point of view, may be regarded as primitive.

Palmaceæ.

In this large family, in many instances, the unbranched habit § and the free carpels are primitive features.

* Harms (1897).
† Hallier (1903).
‡ Strasburger (1905).
§ See Morris (1893).

The Megasporophylls and Megasporangia.

The dictum of Goethe that the carpel is a fertile leaf, more or less modified, has stood unshaken, and there appear to be such ample evidences of its truth that it need not be considered further here. Among the Angiosperms, the condition of apocarpy seems to us to be primitive. The spiral arrangement of the monocarpellary ovaries on a long receptacle, a state of affairs which still survives in the Magnoliaceæ, and in certain other members of the Ranales, may be regarded as a primitive feature of the flower. From this we derive, by suppression of the internodes, the whorled arrangement so characteristic of the great majority of Angiosperms, and often common to all parts of the strobilus. We regard the verticillate grouping as due partly to a tendency to cohesion and adhesion, which has always been marked among the Angiosperms, and partly to a proneness to a dissimilarity in the size and shape of the different organs of the strobilus. The fact that the protective function is, in this type of cone, relegated to sterile members at the base may also have had some bearing on the question ; more efficient protection being perhaps afforded where the axis is reduced in length, and the various organs arranged in whorls. The result has thus been a tendency to a horizontal rather than a vertical distribution of the organs.

There are numerous instances shown by many families, *e. g.*, Ranunculaceæ, Crassulaceæ, and Rosaceæ, of how syncarpy has arisen from apocarpy. In the great majority of the Angiosperms there has been a distinct bias in this direction, with various modifications, the significance of which is to be sought for in the fruits. Bi- and multicarpellary ovaries have been the result.

We regard the carpel as a megasporophyll, present in the ancestor of the Angiosperms as an open leaf, bearing several ovules on its margins, and not unlike the megasporophyll of *Cycas*. With the shifting of the pollen collection from the seed itself to the carpel, it became possible for the latter, both to afford more efficient protection to the developing seeds, by completely closing over them, and also, at the same time, to fulfil its new duties as a pollen receiver, by adopting some mechanism for the purpose at the apex. The necessity for some protection for the ovule is well seen in *Bennettites*, where, however, it is effected in a totally different manner. The style, probably non-existent at first, may be looked upon as a later adaptation, connected with the perfection of the method of insuring cross-fertilisation. The stigmatic surface was, in the early stages, simply a localised portion of the carpel, adapted possibly by some sticky secretion for the collection of pollen.

It need hardly be mentioned that we are in agreement with Bessey *, and other recent writers, in deriving all syncarpous ovaries from apocarpous

* Bessey (1897).

ancestors, and all inferior ovaries from ancestors in which these organs were superior.

The ovule in the primitive Angiosperms was orthotropous. This view is also that commonly held *. From this primitive type were derived the campylotropous and anatropous types.

We are inclined to regard the primitive carpel as multi-ovulate †. There is, however, a constant tendency to reduction in the number of ovules among monocarpellary ovaries. This is especially well seen in an order such as Ranunculaceæ. The significance is to be found in the fruits, which commonly become indehiscent and one-seeded, *i. e.*, achenes.

The Microsporophylls and Microsporangia.

The type of microsporophyll and microsporangium, found almost throughout the living Angiosperms, is a very constant one on the whole, and this indicates that these are organs which have become fixed, although in many cases there is a strong tendency in the direction of abortion, suppression, or transformation. We regard the stamen as a sporophyll, equivalent to the modified foliar organ, which can be shown to have existed in the case of the Pteridospermeæ or Palæozoic ancestor. This sporophyll bears two synangia, each, in some respects, similar to the male organ of a Pteridosperm, e. g., *Crossotheca*. The synangial view of the stamen is by no means a new one, but hitherto no attempt has been made to link it with an ancestor, also possessing this type of microsporangium. We shall endeavour to show at a later stage (pp. 67, 68) that such a view is tenable.

Among living Angiosperms, we regard the andrœcium as primitive in such an order as the Magnoliaceæ, especially as regards the spiral arrangement, the indefinite number, and the form of the microsporophylls and microsporangia. The shortness of the filament, the length of the connective, and its continuation beyond the anther as a sterile tip, are important features in this connection. We are thus in general agreement with Hallier ‡ as regards the microsporophylls of Angiosperms. From such a type of stamen, later stages in evolution have involved modifications of the connective and filament, resulting in the basifixed and versatile types of anther.

The Perianth.

It has been already shown that Angiospermous flowers without a perianth, or those in which this organ is insignificant, occur in plants possessing dense inflorescences. Solitary naked flowers, with many stamens and carpels, are almost unknown to us. In consequence of these two facts, we believe that

* Coulter & Chamberlain (1904) p. 57. † Prantl (1888). ‡ Hallier (1903).

all existing Angiosperms are descended from forms with a conspicuous perianth, and that, in those plants where it is not present, its absence is due to abortion. We are thus inclined to postulate for the group a primitive perianth, which was completely differentiated, from the sporophylls on the one hand, and from the foliage leaves on the other, before the existing Angiosperms came into being. Hence we can hardly seek for its origin among their present-day representatives. At the same time we agree that the modern perianth may have, in certain instances, acquired additional members, either from above by the sterilisation of microsporophylls, or from below by the modification of foliar organs.

On this supposition, let us endeavour to arrive at some idea, from a study of living forms, of what may have been the characters of this primitive perianth, possessed by the immediate ancestors of the existing Angiosperms. Naturally we turn first to the Ranales, for in this group of families, as we have already seen, a number of primitive features appear to be retained in the andrœcium and gynæceum. The special points presented by the Ranalian perianth as a whole, which strike us as primitive, are the inconstant number and spiral arrangement of its members, as well as the absence of a marked separation into calyx and corolla. The perianth of the Magnoliaceæ is of special interest from this point of view, as showing transitions towards a definite number of tepals, arranged in whorls, and a differentation into a calyx and corolla. In *Illicium*, there is a gradual passage from sepaloid to petaloid tepals. In *Drimys*, the distinction between the protective and attractive parts of the perianth is more marked, though they are still spirally arranged. In *Magnolia*, and its close allies, the perianth tends to assume a cyclic arrangement, and the tepals become reduced to a definite number. *M. grandiflora*, L., and *M. stellata*, Maxim., for example, have as many as thirteen perianth members, all much alike. In *M. Yulan*, Desf., they are reduced to nine, arranged in three fairly similar whorls. *M. obovata*, Thunb., and *M. glauca*, Linn., have likewise the same number, but the three outer ones are quite small. The tendency then in this family may be said to be towards a definite perianth, comprised in three whorls. Such a floral envelope, in which as a rule the outer whorl is sepaloid and the two inner petaloid, is a constant feature of the closely allied, but more highly evolved family, the Anonaceæ.

The Ranunculaceæ are perhaps the next most interesting Ranalian family from this point of view, but the perianth here, on the whole, appears to be hardly so primitive, and is complicated by the occurrence of the so-called "honey-leaves," which we regard, in agreement with Prantl *, as recent modifications of some of the outer stamens. We should be inclined to view

* Prantl (1888).

the many-leaved floral envelope of *Trollius*, with its spirally arranged and largely petaloid members, as a primitive perianth.

Without going into further details as regards the Ranales, we believe their perianth can be best explained on the assumption that their ancestors possessed one composed of an indefinite number of members spirally arranged, of which the outer were sepaloid and the inner petaloid, but with no marked separation between the two. Since we regard the Ranales as the most primitive group, we should expect the immediate ancestors of the Angiosperms, as a whole, to have possessed this type of perianth.

Without attempting to follow fully the evolution of the perianth in the higher cohorts of the Dicotyledons, a few tentative remarks here may not be out of place. It might be inferred from the above hypothesis of a primitive perianth, partly sepaloid and partly petaloid, that we would consequently derive the floral envelopes of the higher Polypetalæ and the Gamopetalæ by a marked separation of the sepaloid and petaloid members into two distinct, usually pentamerous whorls, corresponding respectively to the calyx and corolla of these sub-classes. This of course is a possible, and besides a simple view, but there may be other explanations, which appear equally plausible. A. P. De Candolle long ago suggested that all floral leaves are derived from the sterilisation of sporophylls. Čelakovský *, from an exhaustive study of the perianth, finally came to the same conclusion. For the petals, at any rate, this view is supported by the Ranunculaceæ, where the evolution of a "corolla" of honey-leaves, by a modification of stamens, can be traced.

A third origin of the biseriate perianth occurs to us, on the supposition of a primitive floral envelope. The latter may have become wholly petaloid, and persisted as the corolla, whereas the calyx may have been a new structure, derived from foliage leaves.

In the Ranales we believe it is possible to trace the origin of a double perianth in conformity with each of these three theories. As regards the first method—viz., the differentiation of the original simple perianth into a definite calyx and corolla,—the flowers of *Drimys*, and of members of the Anonaceæ, may be instanced. As regards the second, the direct origin of the corolla from stamens may be followed in *Ranunculus*; and with respect to the third—viz., a calyx derived from below through a modification of foliage leaves, or, their direct homologues, bracts,—attention may be drawn to *Anemone Hepatica*, Linn., *Pæonia*, and genera of Dilleniaceæ †.

In fact, the Ranales may be considered an experimental group so far as the formation of a distinct calyx and corolla is concerned, some members progressing in one direction, and some in another.

* Čelakovský (1897) Part II. p. 46.

† Placed in the Cohort Ranales by Bentham and Hooker.

FOSSIL EVIDENCE.

In the foregoing pages we have emphasized certain features exhibited by living Angiosperms, which appear to us to be of a more or less primitive nature. We may now turn to fossil botany to inquire whether we can there gather any evidence of a race of plants, which combines any of these peculiarities.

There occur in the Mesozoic rocks a large number of fossils, which in many respects have much in common with the living Cycads. These plant-remains have been often spoken of as Mesozoic Cycads, and the idea has to some extent become ingrained that, whatever else they may have been, they were essentially Cycads. This conclusion, we believe, is incorrect. It partly arises from the fact that these fossils were for many years, and are perhaps even now, best known to us by impressions of their detached fronds, which are admittedly of the same general type as those of modern Cycads.

Even Wieland * in his quite recent work, in many respects the most important which has ever been done in this direction, has labelled his book 'American Fossil Cycads,' and speaks of the extremely interesting members of the genus *Cycadeoidea* as Cycads. This conclusion we hold to be incorrect, and one which is liable to give rise to a false impression as to the nature of these fossils, many of which we regard as standing nearer to the Angiosperms than to any other group.

For some years past, it has become more and more fully realised, in certain directions, that, among this great plexus of Mesozoic fossils, there were many which could not be called Cycads in the sense that we apply the term to the living plants. It was for this reason that Nathorst †, in 1902, proposed the name Cycadophyta, as a general and non-committal designation for this extensive Mesozoic plexus.

It has also become clear that this group was complex. It includes some plants which were true Gymnosperms, and so nearly allied to the modern Cycads, that, in all probability, they may be regarded as the ancestors of that race. These true Gymnosperms naturally fall within the group Cycadales. As illustrations, we may mention the fact that the type of female fructification exhibited by the living genus *Cycas* is apparently an ancient one. Several examples ‡ of carpellary leaves like those of *Cycas*, in some cases even with seeds attached, are known in the fossil state from rocks of different ages §. Also strobilate fructifications, similar to those of other genera of living Cycads, have been described ‖.

* Wieland (1906) Chapter IX.

† Nathorst (1902) p. 3.

‡ Nathorst (1902) p. 6, pl. 1. fig. 11.

§ Solms-Laubach (1891) p. 86.

‖ Seward (1895) p. 109, pl. 9. figs. 1–4; Nathorst (1902) p. 5, pl. 1. figs. 1–4.

The Bennettiteæ.

Apart from such fossils as may well be included within the term Cycadales, there are others, differing *in toto* as regards the type of fructification. During the last thirty-six years we have gradually come to know more of these Mesozoic plants. The earliest account of their structure relates to *Williamsonia gigas*, described by Williamson *, in 1870. This was followed immediately by the important work of Carruthers † on *Bennettites* and other genera, also founded on British material. Solms-Laubach ‡, some years later, added considerably to our knowledge of this group, from British and Italian specimens of the latter genus. Lignier § has also contributed further information with regard to *Williamsonia* and *Bennettites*, from French material.

From these researches it has become clear that neither of these genera can be regarded as members of the Cycadales, but must be placed in a new group of ordinal rank, the Bennettiteæ ‖.

But by far the fullest, and from our point of view the most important work, which has been carried out on these fossils, is that of Wieland ¶ on the magnificent material of *Bennettites* (*Cycadeoidea*) ** collected from the Jurassic and Cretaceous rocks of the United States. The earlier, preliminary papers †† of this author have now been supplemented by a complete account, published in the sumptuously illustrated volume, entitled 'American Fossil Cycads,' which appeared last autumn. It is to this work that we are specially indebted for the first adequate description of the amphisporangiate strobilus of the genus, as well as for much further information on the subject of the habit and structure of these fossils. Wieland's work has also cleared up many points which were left obscure by the British, French, and Italian material, earlier examined.

This study of the American Bennettiteæ has further emphasized the fact that not only did there exist a great abundance and variety of Cycad-like Mesozoic plants, which cannot be included in the Cycadales, but that some of them warranted the distinction of being regarded as more closely related to the Angiosperms than to Gymnosperms. In fact the Mesozoic Bennettiteæ, as we now know them, appear to afford the long sought for clue to the phylogeny of the Angiosperms, especially on our view of the primitive features of the flower, already discussed.

* Williamson (1870).

† Carruthers (1870).

‡ Solms-Laubach (1890); Capellini and Solms-Laubach (1891).

§ Lignier (1894, 1901, 1903[1], 1904).

‖ This term is now employed in a much wider sense than that originally intended by Carruthers. Engler (1897) pp. 5, 341, adopts the derivative Bennettitales.

¶ Wieland (1906).

** We regard these generic names as synonymous, though we express no opinion as to priority.

†† Wieland (1899, 1901).

It is only proposed here to recapitulate briefly the main points in the morphology of the fructification of *Bennettites*. For a full account the reader is referred to Wieland's excellently illustrated monograph.

The structure of the strobilus is illustrated by figs. 2 & 3 taken from Wieland's book *. As Dr. Scott † has pointed out, it is evident that "in approaching this subject we must divest our minds of all preconceptions drawn from a knowledge of existing Cycadean cones."

Fig. 2.

Diagrammatic sketch of a longitudindal section through the amphisporangiate cone of *Bennettites* (*Cycadeoidea*) *dacotensis*, Ward. About natural size. (After Wieland.)

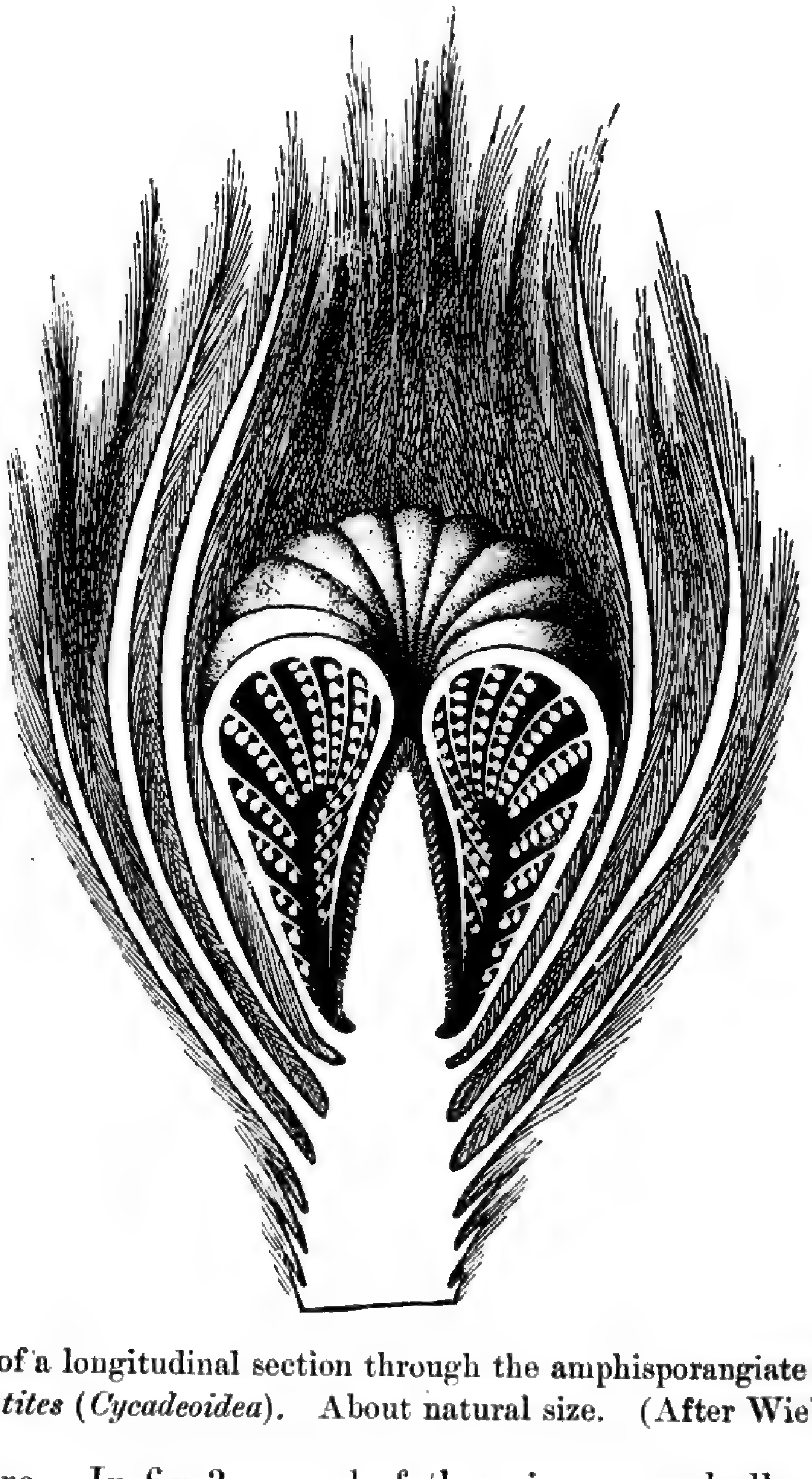
The species, which may be regarded as typical from our point of view, is *Bennettites* (*Cycadeoidea*) *dacotensis*, Ward, from the Black Hills of South Dakota. As is invariably the case in this genus, the fructifications are borne laterally, wedged-in between the persistent leaf-bases of the stem. In all the examples, so far obtained, the cone is quite mature, and has reached the fruiting stage.

* Wieland (1906) text-figs. 87 & 88 on pp. 164–5.

† Scott (1900) p. 454.

The strobilus, which has a length of about 12 cm., consists of an elongated conical axis, bearing several series of bract-like structures below, between which is packed a copious ramentum. Above these bract-like organs, recognised in figs. 2 and 3 by their hairy surface, and attached to the axis in a hypogynous manner, is a structure known as the "disc," formed by the basal cohesion of 18–20 bipinnate fronds, the male sporophylls. In fig. 2, one of the latter is seen in the incurved condition, and the other, as expanded

Fig. 3.



Restoration of a longitudinal section through the amphisporangiate strobilus of *Bennettites* (*Cycadeoidea*). About natural size. (After Wieland.)

when fully mature. In fig. 3 several of the microsporophylls are indicated in the unexpanded state. The bipinnate frond bears many, very reduced pinnules, each supporting two sessile synangia. The microsporophyll is bent inwards in the young state, for about a third of its length, and the secondary rhachides are folded inwards in pairs, lying in the plane of the primary rhachis.

At the apical portion of the strobilus, at a later stage when the

microsporophylls have been shed, a large number of orthotropous seeds are found, mounted on long pedicels, arising directly from the axis. The seeds contain dicotyledonous embryos. Between the seeds, a still larger number of somewhat club-shaped organs, known as the interseminal scales, occur, also attached directly to the receptacle. Distally these scales are all coherent by their apical margins, thus completely covering in the seeds, leaving, however, an orifice directly above each seed, through which the micropylar tube projects. Thus, in the fruiting stage, the interseminal scales form a complete investment or pericarp, and the whole of the macrosporangiate portion of the cone appears to be of the nature of a single fruit. In figs. 2 and 3, the scale is too small to show the young seeds and interseminal scales clearly. Their position, however, lining the apical portion of the axis, is indicated.

Further points in relation to the structure of the fructification of *Bennettites* will be discussed subsequently. We will, however, only add here that Wieland's elucidation of the amphisporangiate cone of *Bennettites* has incidentally extended our knowledge of the earlier described genus *Williamsonia*, in which the fructifications are borne on long peduncles, among the leaves forming the crown at the apex of the stem. It is possible that *Williamsonia*, in these features, is more primitive than *Bennettites*.

Previous Interpretations of the Bennettitean Strobilus.

Before beginning a discussion of the origin of the Angiospermeæ from ancestors nearly related to the Bennettiteæ, we would endeavour to make it clear that we do not consider any known member of the latter group to be exactly on the main line along which the Angiosperms have advanced. They, however, diverge so slightly, that we believe there is now little difficulty in perceiving how the Angiosperms may have originated.

We may commence by considering the interpretations which have been arrived at with regard to the strobili of the known members of the group. In thus reviewing some of the earlier work, it must be remembered that, until recently, the evidence has been very incomplete.

It is curious in this connection to find that in one of the earliest descriptions of the strobili of *Williamsonia*, read by Yates * before the Yorkshire Philosophical Society in 1847, the fructification was interpreted as consisting of "a number of scales, resembling sepals, petals, or perhaps dilated stamens, all growing from the top of the fruit-stalk, and overlapping one another." Yates also points out how very different this cone is, both externally and internally, from the flowers of the Cycads.

Williamson †, working with very incomplete material of the genus *Williamsonia*, distinguished two types of fructification as male and female, which he compared with the cones of living Cycads. Although we know now that this

* Yates (1855) p. 40.

† Williamson (1870) p. 672.

was not a correct conclusion, it was hardly to be expected that a closer approximation to the truth would then have been possible.

Carruthers *, discussing the cone of *Bennettites* in relation to those of the living Cycadeæ, states that "the points of difference are more obvious than those in which they agree. . . . . The fossil is truly gymnospermous, the pollen having access to the embryo-sac through the tubular openings in the covering of the seed, and not through a style developed from an investing carpellary organ. The most remarkable difference is to be found in the compound fruit of the fossil. . . . . It must be considered to hold the same relation to the other Cycadeæ that *Taxus*, with its succulent, cup-shaped pericarp, does to the cone-bearing Coniferæ."

Saporta † regarded the fructification of *Williamsonia* as the fruit of a primitive Monocotyledon, and more especially as belonging to a member of the Pandanaceæ. The same author ‡, in conjunction with Marion, recognised in the interseminal scales the homologues of carpels, and concluded that the inflorescence is similar to a spadix, bearing unisexual flowers, found in certain Monocotyledons.

Solms-Laubach §, when discussing the fructification of *Bennettites Gibsonianus*, Carruth., in 1890, states that its closest affinities among living plants are with the Cycadeæ, though he is not altogether disinclined to accept Saporta's argument that the genus may be found to show analogies in the direction of the Angiosperms. The same author also outlines three hypotheses as to the homologies of the female portion of the strobilus. Either the seed-pedicels and interseminal scales are all carpels, the one fertile and the other sterile; or the scales are of the nature of shoots without leaves, and the pedicels shoots ending in a flower reduced to a single ovule; or, again, the scales are leaves subtending uniovulate shoots. On the whole he inclines to the last of these interpretations.

Similarly, Lignier ‖, in describing the structure of *B. Morierei*, Sap. & Mar., in 1894, concluded that, so far as the female cone is concerned, it is of the nature of an inflorescence, the bracts and interseminal scales being the leaves of the main axis, the seed-pedicels being fertile leaves which belong to unifoliate buds of a higher order. He regards the group as descended from ancestors common to the Cycadeæ, but not from the Cycads themselves, and further suggests that eventually the Bennettiteæ and Cordaitales may be found to have a greater affinity than is at present supposed.

In March 1899, Wieland ¶ described, for the first time, the male flower of *Bennettites* (*Cycadeoidea*) *ingens*, Ward, and showed that it differed entirely from the male cones of the living Cycads. However, as the author ** sub-

* Carruthers (1870) p. 698.
† Saporta (1875) p. 56.
‡ Saporta & Marion (1881) p. 1187; Saporta (1891) p. 88.
§ Solms-Laubach (1890) pp. 830, 832, 843.
‖ Lignier (1894) pp. 69 & 73.
¶ Wieland (1899) p. 224.
** Wieland (1901 and 1906).

...nted out, this strobilus is really amphisporangiate, a fact which not then recognised. In this later communication, Wieland calls attention to the resemblance of this fructification to that of the Angiosperms on the one hand, and to that of the Cycadofilices on the other.

Dr. Scott, in his 'Studies in Fossil Botany' *, sums up the views with regard to the homologies of the Bennettitean cone. He says, "that the axis of the inflorescence is a modified branch of the stem is clear, the enveloping bracts are obviously modified leaves or leaf-bases (*B. Morierei*), and likewise present no difficulty. We might well compare them to the scale-leaves, in which the young cone of an ordinary Cycad is enwrapped." With regard to the seed-pedicels and interseminal scales, "the simplest view, then, would be to regard them as modified leaves, the fertile pedicels being the sporophylls, and the interseminal scales representing either abortive sporophylls or a special kind of bract. But we might also interpret both organs as reduced shoots, or might limit this view to the seed-pedicels, continuing to regard the interseminal scales as bracts, comparable to the paleae found among the florets on the receptacle of some Compositæ."

It must be remembered that, when these views were expressed, our knowledge of the Bennettiteæ was much less advanced than it is at the present time, thanks to the researches of Wieland.

In a later paper, Lignier † adheres to his interpretation of the nature of the female strobilus of the Bennettiteæ, mentioned above, and discusses the morphological value of the cone of *Bennettites* (*Cycadeoidea*) *ingens*. He suggests that the male portion may be of the nature of a flower, that is to say, composed of staminiferous fronds borne on the main axis, though the female is an inflorescence. He also criticises Wieland's comparison of this strobilus with that of the Cycadeæ and Angiosperms. He appears to derive the latter from the Cordaitales ‡. In a later note the same author § discusses the morphology of the interseminal scales.

We now pass to consider the interpretation given by Wieland, who alone has so far had before him the complete evidence of the strobili of the American Bennettiteæ. That author ‖ describes the amphisporangiate axis as a flower homologous with that of an Angiosperm. He speaks of it as follows:—"The flower or strobilus as thus borne on a short and heavy peduncle consists in a terminal ovulate cone surrounded by an hypogynous staminate disc and an outer series of enveloping bracts, followed by the old leaf-bases of the armor" ¶. Comparing this cone with the flower of the Angiosperms, the same author ** concludes:—"It appears that organization into a disc

* Scott (1900) pp. 475–76.

† Lignier (1903[1]) p. 44.

‡ Lignier (1903[1]) diagram on p. 49.

§ Lignier (1904).

‖ Wieland (1906) Chapter VII. & p. 143.

¶ Wieland (1906) p. 165, also p. 235.

** Wieland (1906) p. 230, also p. 79.

preceded by spirally arranged bracts with the subsequent prolonga[...] main floral axis, either as that of a simple terminal cone (or an infloresc[...] is, in later geological time, mainly an angiospermous juxtaposition, althoug[...] it may yet prove that its seemingly isolated occurrence in gymnosperms is largely due to an imperfectly known and understood fossil record."

Discussing the evolution of the Bennettiteæ, contrasted with the Cycads, he says *:—" In the one case the much greater change went on in the megasporophylls, and there was evolved a form of true flower exactly suggestive of the types of change in reproductive organs that resulted in the angiosperms. In the other" [the Cycads] "both types of sporophylls were seized upon and carried forward through the same stages of reduction, save for that single, wonderful, and marvelous survival from the Paleozoic, that analogue of the staminate frond, the carpophyll of *Cycas*."

The present Interpretation of the Fructification of the Bennettiteæ.

Having briefly reviewed previous opinions as to the homologies of the Bennettitean cone, we may pass on to state our own interpretation, which differs considerably from nearly all those previously advocated. According to our view, this cone is a simple strobilus, and not an inflorescence. Its parts are homologous with the carpels, stamens, and perianth of a typical, amphisporangiate, Angiospermous flower. In other words, the simple cone of the Bennettiteæ is an anthostrobilus (see p. 37), differing from the anthostrobilus of the Angiosperm in several important features, especially in the presence of a seminal pollen-collecting mechanism, and in the form of the microsporophylls. Such a fructification may be distinguished as a pro-anthostrobilus (p. 37).

It will readily be seen that this interpretation has all the merit of simplicity. Yet, like most theories, it has certain difficulties peculiar to itself, which will be discussed here. We propose to show that it is possible to institute a very close comparison between the eu-anthostrobilus of the Angiosperm and the pro-anthostrobilus of the Bennettiteæ. Further, the agreement between these two types of anthostrobili is so close that the conclusion that the Angiosperms sprang from Mesozoic ancestors, nearly related to the Bennettiteæ, is rendered extremely probable.

On the view that the pro-anthostrobilus is a simple cone, the term "bract" can no longer be applied to the outer, enveloping, foliar organs. On our interpretation, these constitute a primitive perianth, and are of the nature of sterile leaf-members. The male organs, the 10–20 bipinnate, Marattiaceous-like fronds, are collectively homologous with the andrœcium of the Angiosperms, the stamens of the latter being derived from them by reduction. The position of the microsporophylls on the axis, with regard to the other

* Wieland (1906) p. 66.

organs of the strobilus, is similar to that of the andrœcium of a typical Angiospermous flower, and, with the exception of *Welwitschia*, *is peculiar to this line of descent.* The female organs consist of seeds, mounted on long pedicels, and interseminal scales. We regard the latter as homologous with the carpels of the Angiosperms, despite the fact that they subtend, and do not bear the seed-pedicels. The obvious difficulty which arises from this fact will be discussed later (p. 66). It is this feature, interpreted on the axioms of rigid morphology, which has hitherto biased opinion in favour of interpreting the ovulate portion of the pro-anthostrobilus as an inflorescence. On our view, the carpels of the Bennettiteæ are to a certain degree syncarpous, and this represents a stage in evolution antecedent, in this case, to the method of enclosing the seeds by the infolding of the carpels on themselves. We regard this feature especially as one in which the known Bennettiteæ depart from the direct line of descent of the Angiospermeæ. In their basal cohesion and cyclic arrangement, the male organs show a like early departure.

We regard the fructifications of the Bennettiteæ as having been essentially amphisporangiate, though we recognise the possibility that in this group, as in their descendants the Angiospermeæ, there has been a strong and constant tendency to reduction to the monosporangiate condition, with the corollary of the monœcious and diœcious states. This view has been emphasized so admirably, and at such length by Wieland *, that it is unnecessary to do more than add the following quotation:—"The condition in the great majority of the cones thus far examined is such that one is forced to the conclusion that all the known Cycadeoideæ are descended from bisporangiate forms, and that of all the considerable number of fruits of *Cycadeoidea* and *Bennettites Gibsonianus* or allied species, far the larger portion were actually bisporangiate and discophorous." We may add, in discussing this point, that it must be remembered, that in the majority of the known cones of the Bennettiteæ, the fruits are more or less mature, and often possess a well-developed embryo. At such a stage the microsporophylls would most likely have died down, or, as Wieland expresses it, "wilted," or have been shed altogether, as that author has pointed out at some length. Remnants of the "hypogynous disc," formed by the basal cohesion of the 10–20 microsporophylls, usually remain as sole evidence of the amphisporangiate nature of the cone, except in some 25 known cases, including *Bennettites* (*Cycadeoidea*) *Jenneyana*, Ward, *B.* (*C.*) *ingens*, Ward, *B.* (*C.*) *dacotensis*, Ward, where these organs are preserved. Even in *Williamsonia*, such "discs" have been long known, though their precise nature has only recently been explained by Wieland's work.

That the fructification of the Bennettiteæ presents features recalling those of the Angiosperms has been already pointed out by previous authors.

* Wieland (1906) p. 114, also pp. 130, 137, 169, 174, 184.

Saporta *, in 1871, referred *Williamsonia* to the Monocotyledons on the supposed similarity of the female portion of the strobilus to the fruit of certain Pandanaceæ. In subsequent memoirs this author †, in conjunction with Marion, included the genus in a new class, the Proangiospermeæ, or primitive Angiosperms. Although the evidence for this attribution was then very imperfect, and the deduction by no means warranted or strictly accurate, yet Saporta, in our opinion, was perfectly correct in his happy guess as to the near affinities of this Mesozoic fossil.

In 1880, Nathorst ‡ came to the conclusion that the supposed fruits of the Bennettiteæ really represented parasitic plants analogous to the Balanophoraceæ.

Solms-Laubach's § conclusions have been already mentioned (p. 56). In the English translation (1891) of his 'Fossil Botany,' the following passage occurs :—"It is possible that the seed-stalks may prove to be carpophylls of a peculiar kind ; in that case we should be obliged to separate the Bennettiteæ altogether from the Cycadeæ, and to regard them as an intermediate group between Gymnosperms and Angiosperms."

Dr. Scott ‖ remarked in his 'Studies,' published in 1900, that the fruit of *Bennettites* "comes very near to being angiospermous," but "only in the sense that the seeds were enclosed within a coherent pericarp." The same author concluded that "the Bennettiteæ may well be called pro-angiosperms, to use Saporta's name, if by that we simply mean to indicate plants with a near approach to angiospermous structure, without implying any relationship to the Class Angiosperms as now existing. On the present evidence such a relationship is altogether improbable."

It must, however, be pointed out that it was only in 1901, or, more strictly speaking, during the last year, that the full evidence as to the fructification of *Bennettites* has become available, and consequently these conclusions, founded on imperfect material, could not be other than provisional.

Wieland ¶ in 1901, when describing in a preliminary note the amphisporangiate strobilus of *Bennettites*, emphasized the following suggestion, made in a previous communication : "While the staminate disk surrounding the ovulate axis of *Cycadeoidea* indicates primarily an evolution terminating, so far as now possible to trace, in the Gymnosperms, the juxtaposition of parts is exceedingly suggestive of the possibility, if not the manner as well, of angiosperm development directly from pteridophytic forms. For in these strobili the sporophylls are organized into a flower, ... foreshadowing distinctly the characteristic angiospermous arrangement of stamens inserted on a shortened axis about an ovulate center, apical and sometimes strobilar as seen in *Liriodendron*."

* Saporta (1875) p. 56.

† Saporta & Marion (1885) vol. i. p. 246, and Saporta (1891) p. 87.

‡ Nathorst (1880).

§ Solms-Laubach (1891) p. 97.

‖ Scott (1900) pp. 462, 477, & 478, also p. 523.

¶ Wieland (1901) p. 426.

In 1903, Lignier * criticised Wieland's views with regard to the possible relationship of the amphisporangiate strobilus of *Bennettites* to the Angiosperms, and rejected this theory on the ground that the fructification could not be correctly interpreted as a simple cone.

Of more importance are the opinions expressed by Wieland † in presenting the full evidence with regard to the fructification of *Bennettites,* recently published. He concludes that "it would be most extraordinary if at the present day the angiosperm line of descent could be laid down, except on the broadest lines. It would be most extraordinary, we say, if a mere half-dozen well-understood great plant types scattered over vast periods of time, and representing but a few of a vast array of unknown evolutionary steps, should be exactly the ones enabling us to say, for instance, that certain lines (Cycadofilices) led into the Cycadales and Ginkgoales, and sent off a branch which yielded Cycadeoidean stock *first*, then the Cordaitales, or *vice versa*, and that from these latter the angiosperms sprang." This author ‡ also expresses his conviction that primitive seed-ferns gave rise "to such types as the Mesozoic *Cycadeoideæ*, and, as I believe, at much the same time or a little later than these the early angiosperms."

He defends § the analogy which he previously suggested between the Cycadeoidean flower and that of *Liriodendron*. He says: "Also, in the case of the sole remote type of which we have now gained a fortuitous knowledge, striking analogies to living angiosperms are suggested, no difference whether, laying histological structure somewhat aside, we fasten our attention upon one set of characters and *Liriodendron* be called to mind, or upon another with the result that the male and female catkins of Amentaceæ first suggest themselves, or upon a third set that call to mind some other hint of characters that must have been present in the countless members of a great proangiosperm complex, just as the monocotyl *Pandanus* thus suggested itself to Saporta. We should not ask too much of isolated evidence, nor yet be content with a scant interpretation of highly suggestive facts."

Further he adds ‖: "For the purposes of broader generalization, fern-like fronds upon which were doubtless borne the pollen of *Lyginodendron*, the staminate fronds of *Cycadeoidea* of true Marattiacean type, the mega- and microsporophylls of *Cycas*, the stamens of *Cordaites* and *Ginkgo*, and finally of *Ricinus* and *Liriodendron*, all belong to a series." The same author ¶ also points out other analogies between the Bennettiteæ (Cycadeoideæ) and the Angiosperms.

It will be seen from this short *résumé* of previous opinion that, so far as the full structure of the cone of the Bennettiteæ has been disclosed, there

* Lignier (1903[1]) p. 45.
† Wieland (1906) pp. 243–44.
‡ Wieland (1906) p. 243.
§ Wieland (1906) p. 245.
‖ Wieland (1906) *ibid.*
¶ Wieland (1906) pp. 66, 79, 123, 143.

have already been recognised, on many sides, indications of Angiospermous affinity, and thus support is afforded to the theory maintained here.

Only one discussion of the affinities of the Bennettitean strobilus has appeared, so far as we are aware, since Wieland's full results were disclosed last autumn. Professor Oliver *, in a short paper on this subject, has stated some of the main points of the argument, to which we had arrived independently. He says: "We now come to the question of the morphological interpretation of this fructification, whether it is to be regarded as 'an axis beset with sporophylls,' *i. e.* a flower, or whether, on the other hand, it is really a much more complex structure, *i. e.* an inflorescence or branch-system showing extreme reduction. . . . . . The view taken by Dr. Wieland, that we have here a hermaphrodite flower, will meet with very general agreement. Looked at broadly and having regard to the pteridospermous affinities of the Bennettiteæ this interpretation seems irresistible. To take the other view and read a 'cyathium' into its structure seems to verge on the gratuitous."

The same author adds: "Whatever else one may think of this flower it cannot be regarded as that of a quite typical Angiosperm. . . . . Its great interest and value seem to be that whilst just missing the Angiosperm it shows how close the Cycad line could come to realising it. It is indeed the key to the Angiosperms; when that is recognised the rest is easy . . . . It is possible, no doubt, though it seems almost incredible, that a flower with perianth, stamens, and gynæceum in proper relative position as in *Cycadeoidea* should have been produced except in a line very closely related to that which led to the Angiosperms."

THE HEMIANGIOSPERMEÆ.

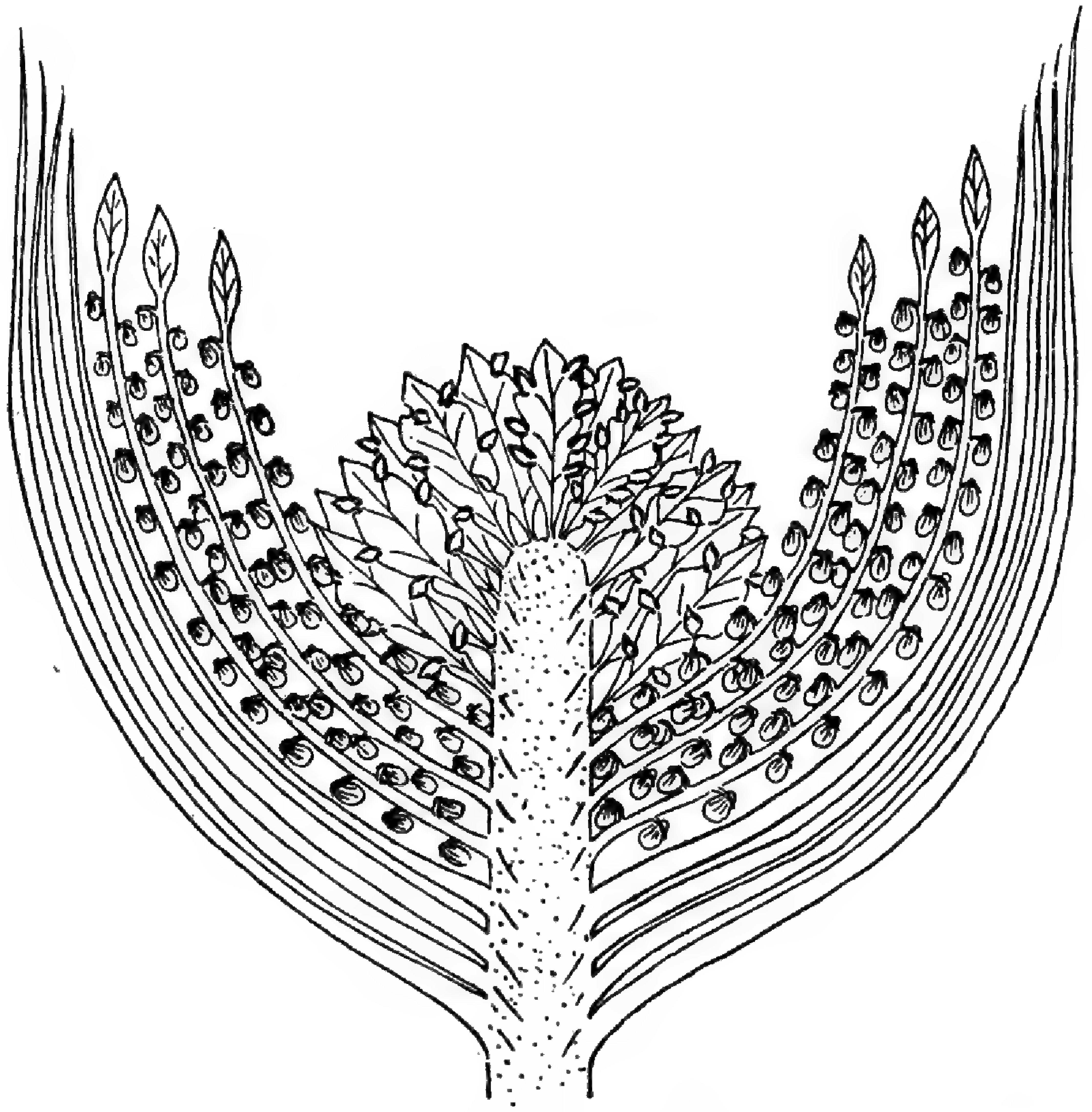
According to our view, the Tertiary and Recent Angiosperms are directly descended from a group of Mesozoic plants to which we apply the new term *Hemiangiospermeæ*. This group at present is entirely hypothetical. Nothing is known as to the fructification of any of its members, but we believe that its cone approximated so closely to the pro-anthostrobilus of the Bennettiteæ, that the latter, although somewhat removed from the direct line of descent, demonstrates emphatically the type of strobilus which gave rise to the eu-anthostrobilus, or flower of the Angiospermeæ. This cone (fig. 4), like that of the closely related Bennettiteæ †, was an anthostrobilus of the pro-anthostrobiloid type. It was also essentially a Gymnospermic fructification, the pollen collection being performed by the ovule itself. Yet it agreed with the typical flower of the Angiosperm on the one hand, and with the strobilus of the Bennettiteæ on the other, in the juxtaposition of the mega- and micro-sporophylls, a feature which is peculiar to the cones of this line of descent,

* Oliver (1906) pp. 239–40.

† Hallier (1901 [1]) p. 105, (1905) p. 154

as well as in the possession of a primitive perianth. It differed from the Bennettitean strobilus in that the megasporangia were seated on the margins of the carpels, the homologues of the interseminal scales, which were free from one another and not united at the apex. Also the microsporophylls were spirally arranged, and perhaps more reduced than those of that group. Such a strobilus would be all but Angiospermic, were it not that the task of pollen collection was still performed by the ovule, and that it lacked the precise form

Fig. 4.



The pro-anthostrobilus of the hypothetical Hemiangiospermeæ. Diagrammatic representation of a longitudinal section through the cone, showing perianth, microsporophylls and megasporophylls.

of microsporophyll which is termed a stamen. The general form of megasporophyll would correspond more closely with that of the living genus *Cycas*, than with the corresponding structures presented by the known Bennettiteæ. That this assumption is a natural one may be inferred from the known antiquity, and frequent occurrence of such a type of megasporophyll in the ancient rocks *.

* See Solms-Laubach (1891) p. 86.

The fact that such a cone appears to be wholly unknown at present should not militate against the theory, if we bear in mind that the total number of Mesozoic fructifications of Gymnospermous affinity at present discovered is extremely small, as Wieland has emphatically pointed out in the passages quoted above.

It might be asked why we have not adopted Saporta's * term, Proangiospermeæ, if some such name is really required. It must, however, be remembered that this name was given to fossils, which were regarded as primitive Angiosperms, combining characters common to both Dicotyledons and Monocotyledons, whereas the hypothetical forms, which we are discussing, were the ancestors of these primitive Angiosperms, and were *Gymnosperms*. Further we do not agree that the Bennettiteæ, in the light of the recent researches of Wieland, can be referred to the Proangiospermeæ † of Saporta, as the latter author concluded, for the same reason that their mode of fertilization was essentially Gymnospermic ‡.

THE ORIGIN OF THE ANGIOSPERMEÆ.

We may now proceed to outline the steps by which the typical strobilus of the Angiospermeæ was evolved from that of the hypothetical Hemiangiospermeæ. We have already (pp. 44–45) indicated what we regard as the primitive form of the various organs which compose the flower.

The amphisporangiate cone of the Bennettiteæ was identical, so far as the juxtaposition of the mega- and microsporophylls is concerned, not only with that of the Hemiangiospermeæ, but also with that of the Angiosperms themselves. The hypogynous arrangement of the parts, as in the Bennettiteæ, was also a primitive feature of the Angiosperms, from which the perigynous and epigynous states have been more recently evolved, as indeed has been pointed out by several writers §.

In the cone of the Bennettiteæ, all the organs are spirally arranged with the exception of the microsporophylls. In the cyclic grouping of the latter, these plants may be regarded as showing evidences of an early departure from the main line of descent of the Angiosperms. In the strobilus of the hypothetical Hemiangiospermeæ, the organs were all arranged spirally (see fig. 4), and this primitive feature is still to be found preserved to some extent

* Saporta & Marion (1885) vol. i. pp. 220 & 222.

† This term is also open to the objection that many fossils have been included under it, the nature or affinities of which are wholly doubtful.

‡ The term 'Angiocycad,' provisionally suggested by Oliver (1906) p. 240, does not appear to us to be free from objections, for we regard the fructification of this ancestor as, in the first place, Gymnospermic, and, in the second, very far removed from that of the living Cycad.

§ Coulter & Chamberlain (1904) p. 13.

among Angiosperms, as for instance among certain members of the Magnoliaceæ. With the Angiosperms generally, just as with the Bennettiteæ, there has been a constant tendency, by suppression of internodes, to derive a cyclic arrangement of the parts of the cone from the primitive spiral type.

The first step in the immediate evolution of the Angiosperms was the transference of the pollen-collecting mechanism from the ovule to the carpel or carpels, with consequent localisation of the stigmatic surface. It was this act which called the Angiosperms into being, as we shall endeavour to emphasize more fully at a later stage in this consideration.

We may therefore first consider the gynæceum.

The Gynæceum.

We regard the Bennettiteæ, so far as the megasporophylls of the cone are concerned, as departing considerably from the main line of descent of the Angiospermeæ. The orthotropous ovule or seed, enveloped by what was probably a single integument *, may be regarded as a fairly primitive structure. In the anthostrobilus of the Angiospermeæ, the primitive condition of the ovule was undoubtedly orthotropous, and probably there was a distinct funicle, a feature which may, or may not, be homologous with the seed-pedicel of the Bennettiteæ. The origin of the second integument does not appear to us to present any great difficulty. It is absent in many living Angiosperms, especially among the Gamopetalæ, and several members of the Ranunculaceæ, an order which we regard as having retained a comparatively large number of primitive features in the strobilus †. Moreover, we regard an integument as a structure which may arise *de novo*, and one without close homologies among those plants which do not bear seeds. That this is the case is evident in such a seed as that of the Palæozoic Lycopod, *Lepidocarpon* ‡, and in certain arils found among living Angiosperms.

The seeds of the Bennettiteæ show a close approximation to those of the Angiosperms in the fact that the embryo of *Bennettites*, and presumably of the Hemiangiospermeæ, possesses two cotyledons, and that, unlike the Cycads, and in all probability the Pteridosperms, these seeds germinated after a comparatively short resting period, both of which we regard as primitive features among the Angiospermeæ.

The structure of the unfertilised ovule of the Bennettiteæ is still practically unknown, for in all the specimens examined so far, the ovule has apparently already become a mature seed. We are, therefore, ignorant of the precise anatomy of the micropylar end of the ovule. Did it possess a pollen chamber, comparable to that of *Lagenostoma*, or was the pollen-collecting mechanism confined to the micropylar region of the integuments? On this point

* Wieland (1906) p. 234.
† Prantl (1888).
‡ Scott (1901) p. 317.

Wieland * gives no clear information. But the fact that the integument, enclosing the micropyle, is produced † beyond the united outer surfaces of the interseminal scales for some 2 mm., or, as Wieland describes it, "projects stigma-like a little beyond the pericarp," seems to show that the latter, whatever their homologies may be, played no part in the pollen-collecting mechanism, a duty no doubt performed by the ovule itself. This also lends probability to the view that pollination was effected by means of anemophily. These points appear to us to be of great importance, since we regard the likelihood that, in the Bennettiteæ and the Hemiangiospermeæ, the pollen-collecting office was performed by the ovule itself (as in the Coniferales and the Pteridospermeæ), and the additional probability that the microspores were brought into position, as it were, by the wind, as being two features eminently characteristic of these groups, as opposed to the Angiosperms.

With regard to the precise homologies of the seed-pedicels and interseminal scales of the Bennettitean fructification, there are already several theories in the field. Lignier's conclusions have been mentioned (p. 56) and Wieland's ‡ views will be found discussed at length in the IXth Chapter of his book. We do not intend to pursue the matter at length here. On our view, the homologues of the interseminal scales of the Bennettiteæ in the cone of the Hemiangiospermeæ were simple carpellary leaves, bearing several ovules on their margins, much like the megasporophylls of the living genus *Cycas*. We conceive that the ancestors of the Bennettiteæ themselves also possessed this type of sporophyll, though in *Bennettites* this structure has become highly modified, perhaps even divided ; for there is a possibility that the seed-pedicels may, in part, represent a lobe of the carpellary leaf. Also the megasporophylls, or portions of them, have become united to form the pericarp of the fruit. In these features we recognise clearly that the strobilus of the Bennettiteæ departs considerably from the lines along which the Angiospermeæ have descended. The evolution of the pericarp of the Bennettiteæ represents one path of advance, and one wholly gymnospermic. On the other hand, the Angiospermeæ, with their closed carpels, form another line of descent, called into being by the adoption of the entomophilous habit, in conjunction with a shifting of the mechanism for pollen-collection from the megaspore itself to the closed megasporophylls.

Since the adoption of entomophily, by means of closed carpels, as the mode of fertilisation, evolution has taken place in many different directions, and thus the great cohorts, families, and orders of Angiosperms have been called into being. Among the more important changes have been reduction and suppression in the number of the floral members, leading in extreme cases to the monœcious and diœcious conditions, often, as we have pointed

* Wieland (1906) p. 122, fig. 63.
† Wieland (1906) pp. 121, 234.
‡ Wieland (1906) p. 230, &c.

out, correlated with increased complexity of the inflorescence; the general replacement of the spiral by the cyclic arrangement in the parts of the flower; cohesion and adhesion, especially the evolution of the perigynous and epigynous states from the primitive hypogyny *; and alterations in symmetry †, notably the evolution of zygomorphic structures. Further in many cases there has been a return to the primitive anemophilous habit, often accompanied by diclinism, and complicated inflorescences.

The Andrœcium.

Perhaps the most striking contrast between the pro-anthostrobilus and the flower or eu-anthostrobilus, is to be found in the nature of the microsporophylls. In the Bennettiteæ, these are bipinnate ‡ fronds of the fern type, coherent at the base, bearing greatly reduced pinnules, which in turn bear synangia. The connection between such organs and the andrœcium of the Angiosperms is not at first sight obvious. If, however, we compare parallel stages in the evolution of the andrœcium and the gynæceum, we may perhaps arrive at a clearer insight on this point.

The seed itself is an exceedingly ancient organ, dating back far beyond the period at which we first became acquainted with fossil plants. In other words, it was a highly evolved structure at a very remote period in geological time. The seed of the Pteridosperms, the earliest stage in the line of descent under discussion with which we are at present familiar, was long antecedent to the evolution of the stamen. The male organs of the Pteridosperms, so far as we have been able to recognise them, were simple synangia-like structures, not dissimilar to those of the Eusporangiate Ferns in certain particulars, and were borne on fern-like fronds. In another Palæozoic group, the Cordaitales, an organ, in some respects closely similar in organisation to a stamen, existed contemporaneously with the fern-like male organ of the Pteridospermeæ, but this line of descent, on our view, has, at the most, only a remote connection with that discussed here. Thus we find that an organ in some respects like a stamen was in existence in the Palæozoic period, although in the Angiosperm line of descent it was not evolved until quite late in geological time.

The fructifications of the Pteridospermeæ, both male and female, were borne in a lax manner, on fronds similar in structure to the sterile fronds, or on leaves in which the lamina was more or less greatly reduced. There is no indication, in any known member of the group, that there was any attempt to aggregate either the male or female fructifications in the form of a strobilus or cone.

* Coulter & Chamberlain (1904) p. 13. † Coulter & Chamberlain (1904) p. 15.

‡ Wieland (1906) p. 165, &c., describes the microsporophylls as "once pinnate." They are, however, obviously bipinnate.

In the case of the Bennettiteæ, however, the Mesozoic descendants of this group, we find both the male and female organs aggregated into an amphisporangiate strobilus, and further that the megasporophylls are of a highly advanced type, and have undergone great reduction, as well as possibly other extreme modifications. The stage reached in the evolution of the microsporophylls is obviously greatly behind that of the megasporophylls. They show hardly any marked advance beyond the condition of affairs met with in the Pteridospermeæ. The microsporophylls are still essentially compound, fertile fronds. Any progress in evolution is confined to the synangium, which is still the dominant type of male fructification. and perhaps more highly evolved in the Bennettiteæ than in any known Pteridosperms. The stamen, *per se*, is quite a recent innovation, so far as this line of descent is concerned. But the adoption of entomophily, by means of closed carpels, which in the ultimate analysis will, we believe, be found to be the real influence which called the Angiosperms into being, no doubt involved considerable modification in other parts of the flower, and among these the male organs. The incoming of this type of pollination, thereby effecting an immense saving in the amount of pollen production necessary to ensure cross-fertilization (see p. 74), seems to have been the signal for considerable reduction in the male fronds of the pro-anthostrobilus. Eventually a much simpler structure has been evolved, consisting of a sporangiophore bearing two synangia.

Although we regard the microsporophyll of the Angiosperms as derived originally from a highly branched organ, by reduction, there would seem to be very few cases among living members of the group in which a survival of this ancient feature can be traced. It is just possible that such may occur among the Myrtaceæ, e. g., *Calothamnus*, and possibly also in *Ricinus*, where the stamens are pinnately branched, but in the Polypetalous orders, such as Capparidaceæ, Dilleniaceæ, Resedaceæ, Hypericaceæ, Cistaceæ, Malvaceæ, &c., in which so-called branched or divided stamens are found, this phenomenon is of a different nature *, and has no direct bearing on this discussion. On the other hand, it is admitted that the gap between the male organs of the Bennettiteæ and the Angiosperms is a big one, and that we are not at present able to trace the various stages in the reduction of the microsporophyll.

The Perianth.

The Bennettitean cone possesses a basal, spirally arranged series of sterile, leaf-like organs, which form an integral part of the strobilus. We imagine that the pro-anthostrobilus of the Hemiangiospermeæ also possessed this feature, which we interpret as an undifferentiated, primitive perianth. With the assumption of entomophily, and the consequent evolution of the Angio-

* Goebel (1905) p. 535.

spermeæ proper, concomitant changes in the form and function of the primitive perianth may well have taken place. To the original protective function of this organ would be added an attractive office, in connection with the entomophilous habit. The changes involved may have affected the perianth as a whole, or only the higher series of its members. While we may suppose that, in some cases, the primitive perianth became differentiated in this way into an outer series the calyx, and an inner series the corolla, it is unlikely that all corollas, or, for that matter, all calyces have originated in this manner. The study of the homologies of the members of the floral envelopes among living Angiosperms is a very difficult one, as we have already pointed out (p. 50). In some cases, e. g., *Nymphæa*, the petals may be modified stamens, *i. e.* degraded fertile sporophylls, as Grant Allen * long ago suggested. In others, foliar structures, not originally forming an integral portion of the cone, may have come to function as a calyx. A well-known example occurs in the case of the involucre of *Anemone Hepatica*, L.†.

While therefore, we reserve for the present a fuller discussion of the homologies of the various types of floral envelopes found among living Angiosperms, we may conclude that at least a part of the modern perianth was derived originally from the ancient primitive perianth of the Hemiangiosperms.

The Angiospermous Type of Foliage.

If our view is correct that the eu-anthostrobilus or flower of the Angiospermeæ has been evolved from the pro-anthostrobilus of an unknown ancestor, allied to the Bennettiteæ, then we may imagine that this evolution would be correlated with a marked change in the habit of the whole plant, especially as regards the branching and leaf-form. We believe, however, that this latter modification took place at a considerably later geological period than the evolution of the flower. In other words, we conceive that the earlier Angiosperms may have retained, for the most part, the unbranched habit, and also the Cycadean type of foliage of their ancestors, for some considerable time after the fructification had become a typical eu-anthostrobilus or flower.

One of the most difficult of the lesser problems which make up the plexus of problems, which we call the origin of Angiosperms, refers to the evolution of the typical form of Angiospermous foliage. The leaves of this group are greatly varied both in form and size, but the majority of them exhibit certain peculiarities of shape and nervation, which, though hard to define, readily permit us to recognise at sight the affinities of such plants, even when we have only their detached foliage to guide us.

* Allen (1882) p. 11. † Goebel (1905) p. 550.

What, then, is the origin of this type of foliage? We believe the solution to the question is to be sought for in a study of the branch-habit. Wieland* has shown clearly that the Bennettiteæ possessed stems of restricted vertical growth, either unbranched or branched only to a limited extent. The same also seems to have been true of the Pteridospermeæ, their ancestors. On the other hand, one of the great characteristics of the Angiosperms, as a whole, is their free branching, whether of the monopodial or the sympodial system. With this change in habit was probably correlated a general alteration in the character of the foliar organs. The Pteridospermeæ, with their unbranched, or tree-fern-like habit, obtained a considerable assimilatory surface by means of very large leaves. Probably, for mechanical reasons, the increase in the size of the leaf as a whole would have to be accompanied by much subdivision of the lamina. Hence the highly compound fronds of the Palæozoic period. The large, but simpler foliage of the Bennettiteæ, and of the Cycadophyta generally, can easily be derived from this type of leaf, and is likewise correlated with a non-branched or feebly branched habit. The association of megaphylly and a simple stem is found in certain living Angiosperms, *e. g.*, the Palms, where it may perhaps be regarded as an ancient feature.

Thus in the Angiosperms as a class, free branching and small leaves have been substituted for a simple unbranched habit and large leaves. One can readily understand how, as the tendency to branching increased, the necessity for microphylly would arise and smaller foliage be evolved. In the one case branching takes place, as it were, in the leaf, in the other, in the stem. Both represent efficiency from a physiological standpoint attained by different methods.

The theory that the origin of the Angiospermous type of branching and consequently the prevailing leaf-form, took place some considerable time after the evolution of the primitive flower is in harmony with the axiom (see p. 35) that corresponding stages in the evolution of the various organs of a seed-plant are not reached contemporaneously. It also explains certain facts which have hitherto been regarded as highly mysterious. When we attempt to summarise the existing data relative to the first appearance of Angiosperms in Neocomian rocks, we are led to three remarkable conclusions. In the first place, the Angiosperms appear to arise very abruptly or suddenly. In the second, judging by their detached leaf-impressions, our sole evidence at present, they belong to highly evolved, and still existing natural orders. There appears to be nothing primitive about these early forms. In the third place, from their first incoming, they are the dominant types in the vegetation of the Cretaceous and Tertiary periods.

* Wieland (1906) Chapter II.

These conclusions are easily explained on the supposition that the earlier Angiosperms still retained the Cycad-like type of foliage of their ancestors; and as our knowledge of the Mesozoic floras is in great part, if not almost entirely, derived from detached leaf-impressions, and not from fructifications, it is not surprising that we have been puzzled by the facts as presented by the geological record. The so-called "sudden appearance" of the Angiosperms in Neocomian times may have no significance as regards the phylogeny of the group, but may well express the fact, that this group, already highly evolved and diversified, then assumed the free-branching habit and consequent microphylly. This hypothesis also explains why this race appears to be dominant over other groups even in the Neocomian period, for the subsidiary incoming stage of the life-line would be masked by the retention of the Cycad-type of foliage.

But, apart from these considerations, the great problem remains as to how the microphyllous foliage of the Angiosperms was derived from the Cycadean type. On this point we are at present unable to offer any suggestion unless we call mutation to our aid (see p. 36). So far we are not aware that fossil botany has afforded evidence of transitions from the type of foliage peculiar to any Mesozoic group to that of the Angiosperms.

THE ORIGIN OF MONOCOTYLEDONS.

It is still a matter of keen debate whether the Dicotyledons or the Monocotyledons are geologically the older group. The arguments are derived, partly from our knowledge of their living members, and partly from a study of fossil impressions. But it may be doubted whether either of these lines of attack afford sufficient data at present to settle the question quite beyond doubt.

Some* have regarded the Dicotyledons as derived from the Monocotyledons, while others†, including Hallier‡, hold the converse, in some cases with the reservation that the Monocotyledons branched off from the main Angiospermous line, *i. e.* Dicotyledons, at a very early period. With the latter view we entirely agree.

So far as the fossil evidence is concerned, we doubt if it is possible to show that either group is really more ancient than the other. We agree with the opinion, now generally held, that the earliest fossil remains, which in the present state of our knowledge we can recognise as clearly belonging to the

* Lyon (1901, 1905).

† Sargant (1903), Mottier (1905), Chrysler (1906), Plowman (1906).

‡ Hallier (1905).

Angiosperms, are those of the Neocomian (Lower Cretaceous) of Portugal and the United States. In these rocks, what appear to be Dicotyledonous and Monocotyledonous leaf-impressions occur together. There have, of course, been many attempts to show that Monocotyledonous leaves are to be found in Mesozoic sediments of pre-Cretaceous age, or even in the Palæozoic. None of these, however, appear to us to afford trustworthy evidence, and in many cases such fossils have been already claimed as members of other groups, such as the Cycadophyta and Cordaitales.

It seems evident that the earlier Angiospermous fossils afford practically no help in attempting to trace the ancestry of the race. Such plant remains consist almost entirely of detached leaf-impressions, which furnish little or no trustworthy evidence, beyond the fact that they are of undoubted Angiospermous origin. In the Tertiary rocks, seeds and fruits, also detached, occur on certain horizons, but impressions of flowers are almost unknown, or at least extremely rare. On the other hand, petrified woods, showing the typical structure of Dicotyledons and Monocotyledons, especially Palms, are found in the Upper Cretaceous and Tertiary formations. These fossils are usually of considerable size, but on the whole hardly advance our ideas in respect to the phylogeny of the group.

On the other hand, the Bennettiteæ, the near relatives of the hypothetical Hemiangiospermeæ, afford some evidence in this connection. As was first pointed out by Solms-Laubach some years ago, the embryo of *Bennettites* has two cotyledons. We imagine that the Hemiangiospermeæ also possessed two cotyledons, and that the Dicotyledonous type was thus more primitive than the Monocotyledonous.

Turning to the living Monocotyledons, we regard this race as one which has become largely specialised, in part to a geophilous, and in part to a hydrophilous * habit. The best explanation of the monocotyledonous embryo is, in our opinion, that put forward by Miss Sargant †. We consider that it is more than probable that the single cotyledon of Monocots, and also of some Dicots, is due to the fusion of the two cotyledons originally present, in response to the geophilous habit.

During the course of evolution there would seem to have been considerable "play upon," or modification of, every unit of the flower. And this appears to us to be true also of the embryo. Late, or far from primitive adaptations are to be found among embryos, just as among flowers. The cotyledonary tubes of some Ranunculaceæ and other families, and the division of labour exhibited by the cotyledons of certain geophilous Peperomias, recently described by Mr. A. W. Hill ‡, appear to us to be cases in point.

In regarding the Angiosperms as a whole as monophyletic, we are in

* Gardner (1883), Henslow (1893) p. 527.

† Sargant (1903, 1904, 1905).

‡ Hill, A. W. (1906).

agreement with Hallier * and Bessey † among others, though the contrary view has been recently upheld by Coulter and Chamberlain ‡. In our opinion, the similarity to be found between the general structure of the amphisporangiate strobili of both Monocotyledons and Dicotyledons, especially in those cases which we regard as preserving primitive features, and the general identity exhibited by the gametophytes, is almost conclusive in this respect. The supposition that such resemblances are due to homoplasy, as Coulter and Chamberlain assert, does not appeal to us, for the chances of such complete parallelism of long duration must be almost infinitely small.

Some evidence also has been recently brought forward to show that the polycotylous embryo may have been derived from a dicotyledonous ancestor, by the splitting of the two seed-leaves §. This, in conjunction with the fact that *Bennettites*, as also *Ginkgo* and living Cycads, possess two cotyledons, inclines us to the view that the dicotylous condition was a primitive feature of the great majority, if not all Spermophyta.

ENTOMOPHILY.

We have already indicated that, on our view, it was a radical change in the method of cross-fertilisation which called the Angiosperms into existence. It is not perhaps safe to assume that the Bennettiteæ, or still more the Hemiangiospermeæ, were wholly anemophilous, though we think there is a strong probability that such was the general method of pollination. At first we may imagine that such insects as visited the Mesozoic ancestors would be attracted to the male sporophylls for the sake of the pollen. In such amphisporangiate strobili as those of the Hemiangiosperms, cross-fertilisation would be likely to result occasionally through insect visitors, owing to the close proximity of male and female sporophylls. In a monosporangiate strobilus, however, the male cones would probably alone be visited, hence there would be no tendency to cross-fertilisation. Consequently the evolution of entomophily may be expected to have arisen in anthostrobiloid plants. In the case of the Angiosperms such primitive entomophily was preserved, and rendered permanent by a transference of the pollen-collecting mechanism from the ovule itself to the carpel or megasporophyll, and by the closure of this organ.

Such a view is in accordance with that expressed by Robertson ‖. The question, however, remains as to why this change in the manner of fertilisation should have necessitated the infolding and union of the carpels. Robertson has recently asked this question, at the same time pointing out that a single ovule could hardly be pollinated any better, and that more than one could not be fertilised as well by the anemophilous method. It might,

* Hallier (1901[2], 1905).
† Bessey (1897).
‡ Coulter & Chamberlain (1904) p. 283.
§ Hill & de Fraine (1906).
‖ Robertson (1904).

however, be argued that the closed condition would be as effective for wind pollination as the open carpel. A definite, receptive part of the closed sporophyll could catch the pollen wafted by wind as easily as the ovule of an open one. True, but on the supposition of a multiovulate carpel, the closed state would not be so effective for anemophily, since the chances are that insufficient pollen would reach the stigmatic surface to fertilise all the ovules. By entomophily, on the other hand, large masses of pollen, sufficient for the fertilisation of all the ovules, would be deposited on the carpel, as the result of a single visit. This view is borne out by the fact that most anemophilous Angiosperms have uniovulate carpels.

There is this further consideration that, by the closing in of the carpel, more efficient protection is afforded to the developing ovules and seeds, and at the same time the chance of their being pollinated is increased by the localisation of the collection mechanism. The insect has only to leave the pollen on one part of the carpel, whereas to fertilise each ovule of a multiovulate open carpel it must be deposited on or near each ovule.

Though agreeing so far with Robertson, we part company with him when he suggests that honey, and not pollen, first attracted insects to flowers. The converse seems to us the more probable, and besides offers a better explanation of how entomophily arose. Otherwise how are we to account for the evolution of floral nectaries? The secretion of honey previous to insect visitation does not appear likely. Afterwards, of course, the plant would gain by substituting this cheaper food-material in the place of pollen. It could then exercise considerable economy in the production of the latter, quite apart from the fact that entomophily in itself is less wasteful in this respect than anemophily. It is unnecessary here to trace further the evolution of the Angiospermous flower under insect influence. This study belongs to a special branch of botany, the main results of which are general knowledge.

While we regard the entomophilous condition as a primitive feature among Angiosperms *, there are numerous instances in which a return to the older, anemophilous habit has, more recently, taken place. These are frequently associated with the more extreme cases of reduction from the amphisporangiate to the monosporangiate condition, accompanied by suppression, often complete, of the perianth. Against the view that such anemophilous plants are primitive may be urged the fact that the inflorescence is almost invariably of a dense, complicated type, while the style, and especially the stigma, are obviously highly evolved structures, fashioned on the same plan as pertains in entomophilous flowers.

* Henslow (1893²) p. 266; Wallace (1889) pp. 323–4.

GENERAL CONCLUSIONS AND SUMMARY.

From a general survey of existing Angiosperms, we have arrived at the conclusion that the Apetalous orders without perianth, such as the Piperales, Amentiferous families, and Pandanales, cannot be regarded as primitive Angiosperms. We thus dissent entirely from the current view, advocated especially by Engler. Engler's theory is criticised on three grounds. Firstly it presupposes that the perianth must arise *de novo*, and be an organ *sui generis*. On the contrary, we surmise that the perianth is an ancient structure, present in the fructification of the immediate ancestors of the Angiosperms. In the second place, the so-called primitive flowers of the above orders are invariably accompanied by a complicated and highly-evolved inflorescence, which we are unable to regard as a primitive character. Thirdly, such a theory is phylogenetically sterile, for, while it has the merit of simplicity, it does not afford any clue to the ancestry of the group, nor does it tend to bring the living Angiosperms into line with the fossil plants of the past. On our view, the primitive and typical Angiospermous fructification is a special form of amphisporangiate cone, distinguished by the peculiar juxtaposition of the mega- and microsporophylls, and by possessing a well-marked perianth. A strobilus exhibiting these features we term an *Anthostrobilus*. The word "flower," which in our opinion should be restricted to the Angiosperms, is used in a great variety of senses. The flower of members of this group is regarded as a special form of the Anthostrobilus, and may be distinguished as an *Eu-anthostrobilus*, of which the distinctive features are the presence of the special type of microsporophyll termed a stamen, and of closed carpels. On our view, however, an earlier form of Anthostrobilus is to be found among Gymnosperms, where, however, the megasporophylls are not closed, and the microsporophylls have not the form which can be called stamens. We designate this latter type a *Pro-anthostrobilus*. This is the form of cone possessed by the Mesozoic Bennettiteæ, and also we believe by the hypothetical, direct ancestors of the Angiosperms, or, as we here term them, the *Hemiangiospermeæ*.

On the strobilus theory of the primitive Angiospermous fructification, we find, when we turn to the fossil evidence, that it is possible to trace the descent of living Angiosperms in its broad outlines. The direct ancestors of this group (the Hemiangiospermeæ) are unknown as yet in the fossil state But on this theory we recognise in the Pro-anthostrobilus of the Mesozoic Bennettiteæ, which we regard as closely related to the Hemiangiospermeæ, features which enable us to restore in some measure the missing fructification of the ancestor. We are helped in this task by what we have termed the law of corresponding stages in evolution, which states that equivalent stages in the evolution of the different organs of one and the same seed-plant are not contemporaneous in point of time. This has proved

especially valuable in the consideration of the origin of the Angiospermous type of leaf, which we suggest was initiated by a change in the branch habit.

We regard the Angiosperms as essentially a monophyletic group, the Monocotyledons having branched off from the Dicotyledonous stock at an early period, probably from the Ranalian plexus. In both these groups entomophily was a primitive feature. We consider that the change, from the assumed generally anemophilous habit of the Mesozoic Hemiangiospermeæ, and the Bennettiteæ, to entomophily, by means of a shifting of the pollen-collecting mechanism from the megasporangium to the megasporophyll, and the consequent formation of an ovary, has supplied the "motive force," which not only called the Angiosperms into existence, but laid the foundation of their future prosperity.

If these conclusions have weight, then it is now possible to trace back the line of descent of the Angiosperms to a very early geological period. This may be shown in tabular form as follows :—

5. Angiospermeæ	Mesozoic and Tertiary (Recent),—Eu-anthostrobilateæ.
4. Hemiangiospermeæ (unknown fossils).	Mesozoic,—Pro-anthostrobilateæ.
3. Pteridospermeæ 2. Heterosporous Fern-like Ancestor. 1. Homosporous Fern-like Ancestor.	Palæozoic,—Non-strobilate Ancestors.

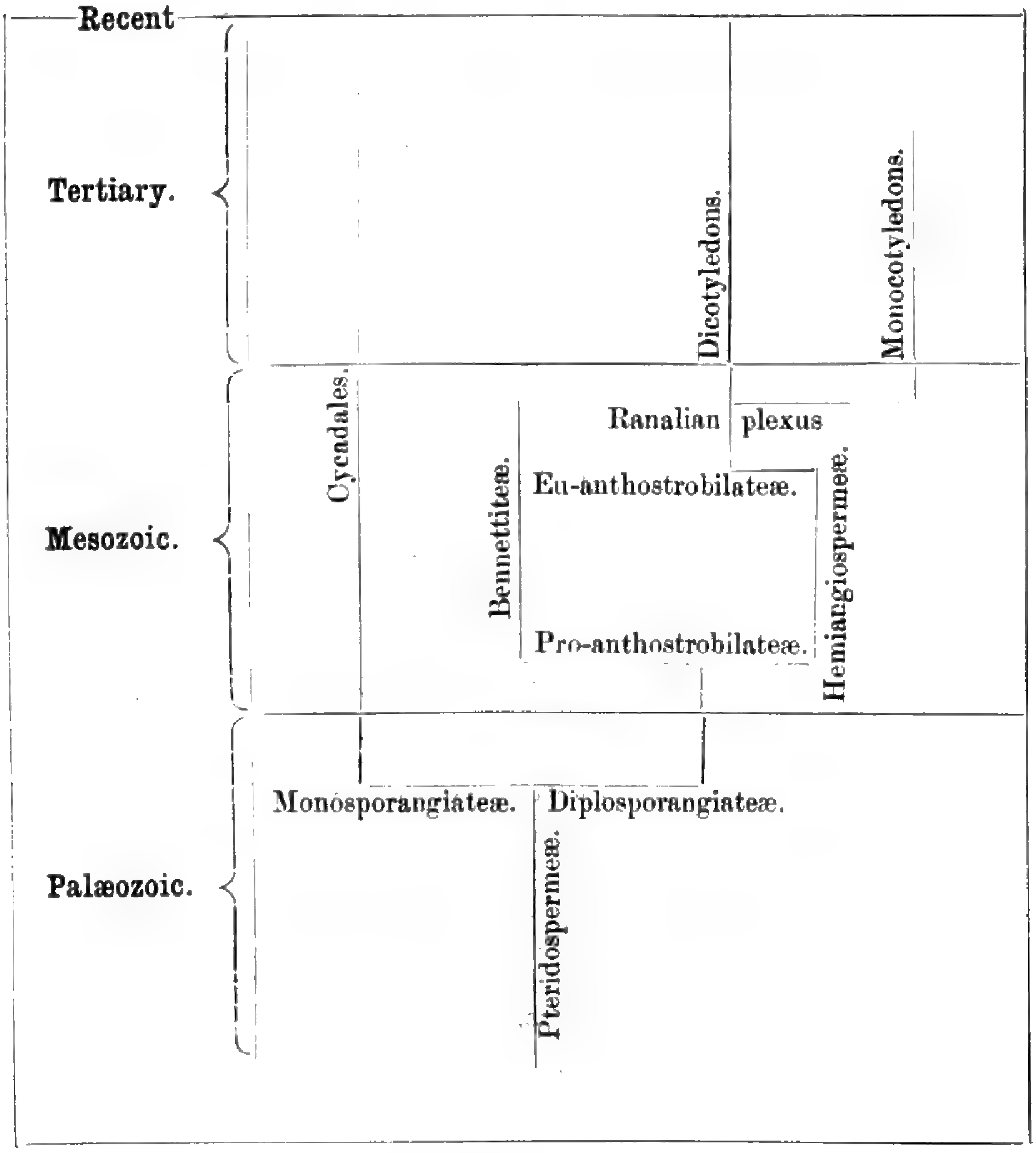
Numbers 1, 2, and 4 are unknown fossils, but the key to numbers 1 and 2 is given by the Pteridospermeæ (No. 3), and to number 4 by the Bennettiteæ. Numbers 3, 4, and 5 were Spermophytes.

Such a theory of descent will permit us to venture rather further afield.

In both the homo- and heterosporous, primitive, fern-like ancestors, there is every reason to believe that the sporophylls were arranged in a lax manner, and not aggregated into definite strobili. This condition still remained a feature of the fern-like seed-plants, or Pteridospermeæ. From this Palæozoic plexus, however, strobilate lines of descent were probably evolved in Mesozoic times by two distinct methods. In the one, like sporophylls were aggregated into monosporangiate cones. In the other, both male and female sporophylls were massed in one amphisporangiate strobilus, the sporophylls however, for a time at least, retaining their primitive, fern-like form, as is clearly seen in the male organs of the Bennettiteæ. The monosporangiate Strobilateæ led to the modern Cycads. This conclusion receives support from the fact that, in the genus *Cycas* itself, only the male sporophylls are aggregated into cones. The female may be regarded as having remained more or less in their ancestral condition, especially with regard to their distribution on the axis. Such a case would be difficult to explain on the

supposition that, in the modern Cycads, the monosporangiate condition was originally derived from a amphisporangiate strobilus. On the other hand, the amphisporangiate Strobilateæ gave rise to other groups, such as the Bennettiteæ and the Angiosperms, in the manner indicated in the following table :—

TABLE OF ANGIOSPERMOUS RELATIONSHIPS.



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THE JOURNAL

OF

THE LINNEAN SOCIETY.

VOL. XXXVIII. **BOTANY.** No. 264.

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Report on the Freshwater Algæ, including Phytoplankton, of the Third Tanganyika Expedition conducted by Dr. W. A. Cunnington, 1904–1905. By G. S. West, M.A., F.L.S., Lecturer on Botany, Birmingham University.

(Plates 2–10.)

[Read 20th December, 1906.]

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I. INTRODUCTION.

The Algæ collected by Dr. Cunnington during his expedition to the large African lakes, in 1904–5, were submitted to me for examination by Dr. Rendle, Keeper of the Botanical Department of the British Museum. Dr. Cunnington's collections were of an extensive nature, and consisted largely of plankton obtained from the three great lakes, Nyasa, Victoria Nyanza, and Tanganyika. A portion of the material was collected in swamps and swampy pools, and a few of the most interesting Algæ were obtained from among the finely divided leaves of certain species of *Utricularia*.

The plankton from Tanganyika is for several reasons of the greatest interest. In the first place, no plankton has previously been reported on from this lake, although accounts have appeared on plankton from both Lake Nyasa and Victoria Nyanza. The species of the phytoplankton are likewise of a very noteworthy character, and the phytoplankton as a whole presents several peculiarities which may be of some slight assistance in the elucidation of the Tanganyika problem.

During recent years a considerable amount of work has been done on the freshwater Algæ of Tropical Africa, but our knowledge of their distribution throughout this vast area still remains very fragmentary and incomplete. No collections have as yet been sufficiently representative, and the published records are both few in number and from districts widely remote from one another. Until much more collecting and systematic examination has been accomplished, it is quite impossible to draw any definite conclusions concerning the geographical distribution of the Algæ in the fresh waters of Tropical Africa.

It would appear that the study of the family Desmidiaceæ is likely to give more valuable evidence regarding a definite region characterized by African types than the investigation of any other family of Algæ, and therefore future collections would have most value if made largely from the permanent and long-standing swamps. Notwithstanding the cosmopolitan nature of no

small number of Desmids, these plants show more decided geographical peculiarities than are to be found among the members of any other large group of Algæ. Even with the present state of our knowledge there is evidence which indicates a very definite Indo-Malayan region, extending to North Queensland, and characterized by certain well-marked types; a second one comprising much of North America and N.W. Europe; and also a third, South-American region, which possibly extends into the South Australian area. The African region may probably embrace Madagascar, and there is also much similarity between some of the Madagascar Desmids and those of Ceylon. More collections of Algæ from Tropical Africa are urgently required consisting of material obtained by carefully squeezing and stripping the aquatic phanerogams and submerged mosses of the swamps.

Only a small proportion of Dr. Cunnington's material was from swamps, and much of that which had been collected from such situations consisted merely of floating Algæ. This at once explains the fact that the Desmidiaceæ recorded in this paper are in no way striking, or, with few exceptions, particularly representative of the African region. Those which may be regarded as of a distinctly African type are the following :—

Euastrum hypochondroides, W. & G. S. W.
E. personatum, W. & G. S. W.
E. pseudopectinatum, Schmidle.
Cosmarium glyptodermum, W. & G. S. W.
C. planum, W. & G. S. W.
C. subauriculatum, W. & G. S. W.
C. multiordinatum, W. & G. S. W.
C. subconstrictum, Schmidle.
Staurastrum limneticum, Schmidle.
S. gracile, Ralfs, var. *subornatum*, Schmidle.

Five Desmids and two filamentous Conjugates I have described as new species.

Of the Chlorophyceæ other than the Conjugatæ, *Œdogonium Kurzii*, Zeller, and *Chodatella subsalsa*, Lemm., are both very interesting species, and seven others I have described as new ; one—*Sphinctosiphon polymorphus,* from the plankton of Victoria Nyanza—having had to be regarded as the type of a new genus. Of the other new forms of green Algæ, *Cœlastrum compositum* differs from all other described species of the genus in the composite grouping of its cells.

The Diatoms were both numerous and peculiar, ten species not agreeing with any previously described. The Diatoms of the plankton are particularly noteworthy, especially those of the family Surirellaceæ.

Numerous Myxophyceæ (or blue-green Algæ) were present both in the plankton and the other collections. The genera *Anabæna*, *Calothrix*, *Lyngbya*,

Phormidium, and *Oscillatoria* were very well represented, and eleven species of various genera have been regarded as new.

The collections were preserved in formalin, and taken as a whole the material was in very good condition for examination.

Considering the somewhat special character of the plankton, and the fact that it constituted one half of the material collected, I have dealt with it separately in the next chapter.

The principal publications on Freshwater Algæ from Tropical Africa, which are particularly important in conjunction with the present paper, are the following :—

F. Cohn : Desmidiaceæ Bongoenses. Festschr. d. naturf. Ges. in Halle, 1879.

C. F. O. Nordstedt : De Algis et Characeis, I. Act. Univ. Lund. xvi., 1880.

—— Conjugatæ. Forschungsr. S.M.S. 'Gazelle,' IV., Berlin, 1888.

E. de Wildeman : Quelques mots sur la flore algologique du Congo. Bull. Soc. roy. bot. Belg. xxviii. 2, 1889.

J. B. De Toni : Algæ Abyssinicæ a cl. Prof. O. Penzig collectæ. Malpighia, Ann. v., fasc. vii.–ix., 1892.

G. v. Lagerheim : Chlorophyceen aus Abessinien und Kordofan. La Nuova Notarisia, ser. 4, 1893.

W. West & G. S. West : A Contribution to our Knowledge of the Freshwater Algæ of Madagascar. Trans. Linn. Soc. ser. 2 (Bot.) v. part 2, 1895.

—— —— Algæ from Central Africa. Journ. Bot. xxxiv. 1896.

—— —— Welwitsch's African Freshwater Algæ. Journ. Bot. xxxv. 1897.

W. Schmidle : Die von Professor Volkens und Dr. Stuhlmann in Ost-Africa gesammelten Desmidiaceen. Engl. Bot. Jahrb. xxvi., 1898.

—— Beiträge zur Algenflora Afrikas. Engl. Bot. Jahrb. xxx., 1901.

—— Schizophyceæ, Conjugatæ, Chlorophyceæ in A. Engler, Die von W. Goetze am Rukwa- und Nyasa-See etc. ges. Pflanzen. Engl. Bot. Jahrb. xxx., 1902.

—— Algen, insbesondere solche des Plankton, aus dem Nyassa-See und seiner Umgebung, gesammelt von Dr. Fülleborn. Engl. Bot. Jahrb. xxxii., 1903.

—— Das Chloro- und Cyanophyceenplankton des Nyassa und einiger anderer innerafrikanischer Seen. Engl. Bot. Jahrb. xxxiii., 1904.

O. Müller : Berichte über die botanischen Ergebnisse der Nyassa-See und Kinga-Gebirgs-Expedition, VII. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. Engl. Bot. Jahrb. xxxiv., 1905 ; xxxvi., 1905.

II. THE PHYTOPLANKTON.

General remarks.—The observations on the phytoplankton of Lake Nyasa, Victoria Nyanza, and Lake Tanganyika are largely concerning the occurrence of certain species, and it has been a matter of no small difficulty to identify with certainty some of these plankton-forms. With regard to the species which were present in the collections, the examination of the material has been fairly exhaustive, but owing to the restricted explorations little can be said about the periodicity, or concerning any maximum development which these species may attain. In Lake Nyasa the material was collected in

June 1904, and is chiefly interesting in comparison with material collected by Dr. Fülleborn (1898–1900) and reported upon by Schmidle *. In Victoria Nyanza the material was collected in April 1905, and again the chief interest lies in a comparison with Schmidle's report † upon material collected by Dr. Stuhlmann in Oct. 1892. From Tanganyika, however, the collections were much more extensive, ranging from July 1904 to Feb. 1905, and this is the more gratifying as there are no previous records of phytoplankton from this lake.

The phytoplankton of these large African lakes is at once peculiar in the absence of many genera which are a dominant feature of the European lake-plankton. Most noticeable in this respect are the genera *Dinobryon*, *Asterionella*, *Tabellaria*, *Rhizosolenia*, and *Cœlosphærium*. Schmidle has already commented ‡ upon the absence of *Dinobryon* from Lake Nyasa, and it is similarly absent from both Victoria Nyanza and Tanganyika. In temperate Europe and N. America this genus is one of the most conspicuous of plankton-organisms, having a well-marked maximum period, and it also occurs in abundance in the lakes of more northern latitudes. Its absence from the plankton of the tropics is perhaps due to unsuitable conditions of temperature, as this genus appears to attain its maximum in the European plankton at a temperature below 15° C., whereas the mean temperature of Tanganyika is about 24·7° C. The absence of *Asterionella* and *Rhizosolenia* may be due to the same cause, viz., too high a temperature, the latter genus attaining its maximum in certain European lakes at a temperature below 10° C. The genus *Tabellaria* is absent from the plankton, but *Tabellaria flocculosa* has been observed from other situations in Angola, W. Africa.

Sphærocystis Schroeteri is also absent from the collections of phytoplankton which have so far been made in these great African lakes, and as Schmidle has also commented upon its absence from the plankton of Lake Nyasa §, even from collections extending over a period of ten or eleven months, it would appear that the Alga in question is entirely absent from this lake. It is likewise absent from the Tanganyika collections, which are fairly representative of eight months of the year; but, strange to say, it occurred in great abundance in two samples of plankton from the Lofu River which runs into Tanganyika.

The Desmidiaceæ are poorly represented in the plankton of Tanganyika and Lake Nyasa, but in the plankton of Victoria Nyanza Desmids play a conspicuous part. This was not only the case in Dr. Cunnington's material collected in April 1905, but also in Dr. Stuhlmann's material collected in October 1902 ‖. The plankton of Victoria Nyanza thus compares favourably

* W. Schmidle, in Engler, Bot. Jahrb. xxxii. (1903).

† W. Schmidle, *l. c.* xxvi. (1898).

‡ W. Schmidle, *l. c.* xxxii. (1903) p. 8.

§ W. Schmidle, *l. c.* xxxii. (1903) p. 8.

‖ W. Schmidle, *l. c.* xxvi. (1896) p. 6.

with that of the British lakes with regard to its Desmid-flora. Moreover, the most abundant Desmid is *Staurastrum limneticum*, Schmidle, a species of a similar type to *S. Ophiura*, Lund., which latter is generally distributed in many lakes of the western areas of the British Islands.

The Surirellaceæ are well represented, and certain handsome species of *Surirella* seem to have firmly established themselves in the plankton. This is again strictly comparable to the establishment as plankton-species of several large *Surirellas* in the Scottish and Irish lake-plankton *. *Cymatopleura Solea* seems also in many cases to have become a plankton Diatom, and in the plankton of Victoria Nyanza there is a large species which I have named *Cymatopleura Nyansæ*.

Species of *Cœlosphærium*, which constitute no small amount of the European lake-plankton at certain seasons of the year, appear to be quite absent from these African lakes.

As in the European plankton, there is a tendency among certain of the Algæ to a spiral growth, which results in the production of close-coiled filaments. In the Scottish and Irish plankton this feature was principally confined to the filaments of *Anabæna Flos-aquæ* and *A. circinalis*, to certain of the small species of *Mougeotia*, and to the disposition of the frustules in the colonies of *Asterionella* and *Tabellaria*. In the African plankton a spiral twisting is a conspicuous feature of the *Anabæna*-filaments, but the spirals are of a more regular type and the filaments relatively much shorter. In *Lyngbya circumcretum* the same tendency to spiral growth has resulted in the formation of short spiral filaments which have the appearance of little coils of wire. The same spiral character is exhibited by *Lyngbya contorta*, Lemm. Ostenfeld † has described and figured from a lake in Iceland, and Volk ‡ has mentioned as occurring in the Elbe, a similar coiled condition of the filaments of *Melosira granulata*.

It has already been suggested § that the development of this coiled condition is a limnetic character, and it is certainly of great interest to find this character in so many different species and genera of the phytoplankton. Lemmermann ‖ attributes the curvature of the *Melosira*-filaments to the movements of the water. This may be so, but how is it that the majority of *Melosira*-filaments met with in the plankton are quite straight? The filaments

* W. & G. S. West, in Trans. Roy. Soc. Edinburgh, xli. part 3 (1905), p. 515, t. 1. figs. 2–4, t. 2. figs. 4 & 6. W. & G. S. West, in Trans. Roy. Irish Acad. xxxiii. sect. B (1906), p. 89, t. 6. figs. 1 & 3, t. 8. figs. 2 & 3, t. 9. fig. 6.

† C. H. Ostenfeld, in Botanisk Tidsskrift, xxvi. (1904) p. 233, fig. 5 (p. 232).

‡ R. Volk, Hamburgische Elb-Untersuchung I., Hamburg, 1903, p. 113.

§ W. & G. S. West, in Journ. Linn. Soc., Bot. xxxv. (1903) p. 524 (*Mougeotia* sp.) Ostenfeld, 1904, *l. c.* p. 233 (*Melosira granulata* f. *curvata*, Grun.); W. & G. S. West, in Trans. Roy. Soc. Edinburgh, xli. (1905) p. 497 (*Mougeotia* sp.).

‖ E. Lemmermann, in Ber. Deutsch. Bot. Ges. xxii. (1904) p. 17.

of *Melosira granulata* and of *M. nyassensis* in the African plankton were either quite straight or almost straight, and the same remarks apply to the species of *Melosira* in the Scottish and Irish plankton. Ostenfeld points out that the *Melosira*-filaments are straight in the Danish plankton *, but commonly coiled in plankton he examined from a lake in Iceland.

I am not aware of a definite spiral character, such as the one just mentioned, having been developed by any Algæ other than limnetic species †, and another equally well-marked limnetic feature is exhibited by certain of the smaller species of *Synedra*, in which there is a tendency to assume a colonial character owing to the grouping of the frustules in radiating clusters ‡.

Special characters of this nature, which appear only to be fully acquired in the plankton, are most probably directly concerned in increasing the floating-capacity of the species; and the rearrangement of the mucus enveloping all these plants to a greater or less degree, which must be caused by the acquirement of such peculiarities, may also assist their capabilities of suspension.

A strict comparison between the phytoplankton of the three lakes is not possible from the present material, owing to the fact that the collections from each lake were not made at the same seasons of the year. Nevertheless, considerable differences exist which are in no way due to seasonal variations of the plankton-organisms, and these differences are of a highly interesting character. A more complete comparison can be made between Tanganyika and Lake Nyasa than between either of these lakes and Victoria Nyanza, as collections from the two former lakes extend over a corresponding period of about eight months.

The table immediately following has been constructed to show all the species which have been observed in Dr. Cunnington's plankton-collections; after which are paragraphs relating to the peculiarities of the plankton of each lake, Tanganyika receiving rather fuller treatment than the others.

* *Cf.* also C. Wesenberg-Lund, 'Studier over de danske Söers Plankton,' Kjöbenhavn, 1904.

† In the genera *Spirulina* and *Arthrospira* the filaments are usually very much longer and the spirals of much less diameter than in the limnetic spirally-twisted forms. *Spirulina laxissima*, a new species from the plankton of Tanganyika, is particularly interesting, as in correlation with its limnetic existence the filaments are short and the spiral twists of much greater diameter than usual.

‡ Lemmermann has created a subgenus "*Belonastrum*" for the plankton-species which form these stellate or radiating clusters. *Cf.* Ber. Deutsch. Bot. Ges. xviii. (1900) p. 30. In this subgenus of *Synedra* Lemmermann places four species (*S. actinastroides*, *S. berolinensis*, *S. revaliensis*, and *S. limnetica*) and several varieties, of which he gives a summary in the same Journal, xxiv. (1906) pp. 537, 538.

General Table of Phytoplankton.

Species.	Nyasa.	Victoria Nyanza.	Tanganyika.
Chlorophyceæ.			
Closterium Leibleinii, Kütz.	....	....	×
Cosmarium depressum, (Näg.) Lund.	....	×	
" *contractum*, Kirchn., var. *ellipsoideum*, (Elfv.) W. & G. S. West.	....	×	
" *moniliforme*, (Turp.) Ralfs	....	×	
Arthrodesmus Incus, (Bréb.) Hass., forma	....	×	
Staurastrum cuspidatum, Bréb.	....	×	
" *brevispinum*, Bréb., var. *inerme*, Wille	....	×	
" *alternans*, Bréb.	....	....	×
" *setigerum*, Cleve, var. *Nyansæ*, Schmidle	....	×	
" *tohopekaligense*, Wolle	....	×	
" *leptocladum*, Nordst., forma *africanum*	×	×	
" *gracile*, Ralfs, var. *subornatum*, Schmidle	....	×	
" " var. *protractum*, var. n.	×		
" " var. *Nyansæ*, var. n.	....	×	
" *anatinum*, Cooke & Wills, var. *subglabrum*, var. n.	....	×	
" *limneticum*, Schmidle	....	×	
" " var. *aculeatum*, Lemm.	....	×	
Sphærozosma excavatum, Ralfs	×		
Hyalotheca mucosa, (Dillw.) Ehrenb.	....	....	×
Pediastrum simplex, Meyen	×	×	×
" " forma *Sturmii*, (Reinsch) nob.	×		
" " var. *clathratum*, (Schröt.) nob.	×	×	
" " " forma *radians*	×		
" " " forma *microporum*	....	×	
" " " forma *ovatum*	×	×	
" *duplex*, Meyen	....	×	×
" " var. *clathratum*, A. Br.	....	×	
" " var. *reticulatum*, Lagerh.	....	×	
" *Boryanum*, (Turp.) Menegh.	×	....	×
" " var. *rugulosum*, var. n.	....	×	
" *Tetras*, (Ehrenb.) Ralfs	....	....	×
" " var. *longicorne*, Racib.	×		
" *integrum*, Näg.	....	....	×
Cœlastrum sphæricum, Näg.	×	×	
" *microporum*, Näg.	×	×	
" *cambricum*, Arch.	×		
" " var. *intermedium*, (Bohlin) nob.	×		
" " var. *nasutum*, (Schmidle) nob.	....	×	
" *reticulatum*, (Dang.) Senn.	×	×	
" *compositum*, sp. n.	....	×	
Sorastrum Hathoris, (Cohn) Schmidle	....	×	
Crucigenia tetracantha, sp. n.	....	....	×
Scenedesmus bijugatus, (Turp.) Kütz.	....	....	×
" " forma *arcuatus*, (Lemm.) W. & G. S. West.	....	....	×
" *acutiformis*, Schröder, var. *brasiliensis*, (Bohlin) W. & G. S. West.	....	....	×
" *quadricauda*, (Turp.) Bréb.	×	....	×
" " var. *maximus*, W. & G. S. West	....	×	×
Dimorphococcus lunatus, A. Br.	....	×	

Species.	Nyasa.	Victoria Nyanza.	Tanganyika.
CHLOROPHYCEÆ (*continued*).			
Ankistrodesmus falcatus, (Corda) Ralfs, var. *spirilliformis*, G. S. West.	....	....	×
" *nitzschioides*, sp. n.	....	....	×
Closteriopsis longissima, Lemm.	×	×	
Selenastrum gracile, Reinsch	....	×	
Kirchneriella obesa, (West) Schmidle	....	×	
Oocystis lacustris, Chodat	×	×	×
" *parva*, W. & G. S. West	×		
Tetraëdron minimum, (A. Br.) Hansg.	....	....	×
Cerasterias rhaphidioides, Reinsch	....	....	×
Richteriella botryoides, (Schmidle) Lemm., forma *quadriseta*, (Lemm.) Chodat.	....	....	×
Chodatella subsalsa, Lemm.	....	....	×
Dictyosphærium pulchellum, Wood	×	×	×
Botryococcus Braunii, Kütz.	×	×	×
Ineffigiata neglecta, W. & G. S. West	....	×	
Tetracoccus botryoides, West	....	....	×
Sphinctosiphon polymorphus, gen. et sp. n.	....	×	
Glœocystis gigas, (Kütz.) Lagerh.	....	×	×
Bacillarieæ.			
Melosira granulata, Ralfs, var. *angustissima*, O. Müll.	×	×	
" *nyassensis*, O. Müll.	×	×	
Cyclotella Kützingiana, Chauvin	×	×	
" *operculata*, Kütz.	×	....	×
" *compta*, (Ehrenb.) Kütz.	....	×	
Stephanodiscus Astræa, (Ehrenb.) Grun.	×		
" " var. *spinulosus*, Grun.	×	×	
" " var. *minutulus*, (Kütz.) Grun.	×		
Synedra Acus, Kütz.	....	×	×
" " var. *delicatissima*, (W. Sm.) Grun.	×	×	×
" " var. ? (= *S. revaliensis*, Lemm.)	....	....	×
" *actinastroides*, Lemm.	....	....	×
Cocconeis Pediculus, Ehrenb.	....	....	×
" *Placentula*, Erhenb.	....	....	×
Navicula Tanganyikæ, sp. n.	....	....	×
" *elliptica*, Kütz.	×	....	×
" *Pupula*, Kütz.	....	....	×
" *mutica*, Kütz.	×		
" *Crucicula*, (W. Sm.) Donkin	×		
" *bahusiensis*, Grun.	×	....	×
" *radiosa*, Kütz.	....	×	×
" *rhynchocephala*, Kütz.	×	....	×
" *distincta*, sp. n.	....	....	×
" *Gastrum*, Ehrenb.	×	....	×
Schizostauron Crucicula, Grun.	....	....	×
Gyrosigma attenuatum, (Kütz.) Cleve	....	....	×
" *nodiferum*, (Grun.) nob.	....	....	×
Cocconema grossestriatum, (O. Müll.) nob., var. *Tanganyikæ*, var. n.	....	....	×
" *cymbiforme*, Ehrenb.	×	....	×
" *Cistula*, (Ehrenb.) W. Sm., var. *maculata*, (Kütz.) Cleve.	....	×	

Species.	Nyasa.	Victoria Nyanza.	Tan-ganyika.
Amphora ovalis, Kütz.	....	....	×
„ *coffæiformis*, (Ag.) Kütz.	....	....	×
Epithemia turgida, (Ehrenb.) Kütz.	×	×	×
Rhopalodia gibba, (Kütz.) O. Müll., var. *ventricosa*, (Grun.) O. Müll.	....	×	×
„ *hirudiniformis*, O. Müll.	×	×	×
„ *gracilis*, O. Müll.	....	....	×
„ „ var. *undulata*, O. Müll.	×		
„ *vermicularis*, O. Müll.	×	×	
Nitzschia Tryblionella, Hantzsch, var. *littoralis*, (Grun.) Van Heurck.	....	....	×
„ *Lancettula*, O. Müll.	×		
„ *dissipata*, (Kütz.) Grun., var. *media*, Hantzsch.	....	....	×
„ *tubicola*, Grun.	....	....	×
„ *Palea*, (Kütz.) W. Sm.	....	×	×
„ *nyassensis*, O. Müll.	×	....	×
Surirella Fülleborni, O. Müll.	....	×	
„ „ var. *elliptica*, O. Müll.	....	×	
„ *bifrons*, (Ehrenb.) Kütz., var. *tumida*, O. Müll.	×	×	
„ „ var. *intermedia*, O. Müll.	×		
„ *Malombæ*, O. Müll.	....	×	
„ *Nyassæ*, O. Müll.	×		
„ *plana*, sp. n.	....	....	×
„ *constricta*, Ehrenb., var. *africana*, O. Müll.	....	....	×
„ *obtusiuscula*, sp. n.	....	....	×
„ *Tanganyikæ*, sp. n.	....	....	×
„ *striatula*, Turp.	....	....	×
Cymatopleura Solea, (Kütz.) W. Sm.	×	×	×
„ „ var. *laticeps*, O. Müll.	×		
„ *Nyansæ*, sp. n.	....	×	
Myxophyceæ.			
Nostoc piscinale, Kütz.	....	....	×
„ *carneum*, Ag.	....	....	×
Anabæna Flos-aquæ, (Lyngb.) Bréb., forma	×	....	×
„ „ var. *circularis*, var. n.	....	....	×
„ sp. ? (fil. rigidissim.)	....	....	×
„ *Tanganyikæ*, sp. n.	....	....	×
„ sp. ? (fil. contort.)	×		
Plectonema Wollei, Farlow	....	....	×
Lyngbya bipunctata, Lemm.	×		
„ *circumcreta*, sp. n.	....	×	
„ *limnetica*, Lemm.	....	....	×
„ *perelegans*, Lemm.	....	....	×
Phormidium tenue, (Ag.) Gom.	....	....	×
„ *angustissimum*, W. & G. S. West	....	....	×
Oscillatoria princeps, Vauch.	....	....	×
„ *Cortiana*, Menegh.	....	....	×
„ *Tanganyikæ*, sp. n.	....	....	×
„ *tenuis*, Ag.	....	....	×
Spirulina laxissima, sp. n.	....	....	×
Glœotrichia longiarticulata, sp. n.	×		
„ *natans*, (Hedwig) Rabenh.	....	....	×
Dactylococcopsis africana, sp. n.	....	×	

Species.	Nyasa.	Victoria Nyanza.	Tanganyika.
MYXOPHYCEÆ (*continued*).			
Merismopedia elegans, A. Br.	....	....	×
„ „ var. *remota*, var. n.	....	....	×
„ *æruginea*, Bréb.	....	....	×
„ *glauca*, (Ehrenb.) Näg.	....	....	×
„ *punctata*, Meyen	....	....	×
Gomphosphæria aponina, Kütz.	....	....	×
„ *lacustris*, Chodat	×	×	
Microcystis viridis, (A. Br.) Lemm.	×	×	
„ *æruginosa*, Kütz.	×	×	
„ *elabens*, (Bréb.) Kütz.	....	....	×
„ *incerta*, Lemm.	....	×	
Chroococcus minimus, (Keissler) Lemm.	×		
„ *turgidus*, (Kütz.) Näg.	....	....	×
„ *pallidus*, Näg.	....	×	
Peridinieæ.			
Glenodinium Pulvisculus, (Ehrenb.) Stein.	....	....	×
Peridinium africanum, Lemm., sp. n.	×	....	×
„ *berolinense*, Lemm., var. *apiculatum*, Lemm., var. n.	....	....	×
Peridiniopsis Cunningtonii, Lemm., sp. n.	....	....	×
Ceratium Hirundinella, O. F. Müll., forma	....	×	

Phytoplankton of Nyasa.—This lake lies between 9° 30′ and 14° 25′ S. lat., its long axis running almost north and south. It is about 400 miles long, with an average width of 25 miles, and is 1570 ft. above sea-level. Its area is about equal to that of Tanganyika. The phytoplankton has been fairly well investigated by Schmidle from material collected at intervals from April 1898 to Dec. 1900 by Dr. Fülleborn. Schmidle reported upon the species he found in the plankton, the periodicity of the genera so far as he was able to work it out, and the vertical depth to which the various genera extended in the lake. Nyasa is shallow at the north end and very deep towards the south end, no bottom having been found in several places at 1200 feet. Schmidle states that the phytoplankton extends in no trifling quantity to fully 300 ft. from the surface, and at this depth consists principally of Diatoms, with a few Chlorophyceæ and Myxophyceæ.

In Dr. Cunnington's material, collected in June 1904, Chlorophyceæ were not very abundant, and those which did occur were mostly representatives of the Protococcoideæ. Only three Desmids were observed, one of which—*Staurastrum leptocladum* forma *africanum*—was in moderate abundance. Forms of *Pediastrum simplex* and species of *Cœlastrum* were very abundant, and in some of the collections *Closteriopsis longissima* was fairly common. The Diatoms comprised relatively few genera, of which *Melosira*, *Cyclotella*,

Stephanodiscus, and *Surirella* were conspicuous. A few species of *Navicula* were not uncommon and *Nitzschia nyassensis* was frequent. *Surirella Nyassæ* and *S. bifrons* were very characteristic, the former being a large and handsome species which is apparently peculiar to this lake.

Some of the collections, more especially nos. 15 and 16, were remarkable for the prodigious abundance of a form of *Anabæna Flos-aquæ*. The other Myxophyceæ of importance were *Lyngbya bipunctata* and *Glœotrichia longiarticulata*, sp. n.

A species of *Peridinium*, which Lemmermann has described as *P. africanum*, occurred abundantly in some of the material.

Phytoplankton of Victoria Nyanza.—This large sheet of water extends from 0° 25′ N. to 3° S. and from 31° 45′ to 34° 45′ E., occupying an area of 32,167 square miles. Its greatest length is 180 miles and its greatest width 208 miles, its height above the sea being about 3800 ft. The depth is very variable, from about 6 ft. (at 2 miles from the shore) in Speke Gulf in the south to 300 ft. towards the middle, and 620 ft. near the eastern shore.

The material was collected in April 1905, and was decidedly rich in Chlorophyceæ, especially Protococcoideæ and Desmidiaceæ. Of the latter, *Staurastrum limneticum* and *S. tohopekaligense* occurred in great abundance, and *S. leptocladum* forma *africanum*, *S. brevispinum* var. *inerme*, forms of *S. gracile*, and *Cosmarium moniliforme* were fairly common. The Protococcoideæ were both abundant and of diverse character. Conspicuous were numerous forms of *Pediastrum simplex* and large cœnobia of *Cœlastrum reticulatum* and *C. cambricum* var. *nasutum*. *Cœlastrum compositum* is a previously undescribed species in which the grouping of the cells is very peculiar. Fine colonies of *Dimorphococcus lunatus* were not uncommon, and the colonies of *Selenastrum gracile* were the largest and best-developed I have ever seen. *Closteriopsis longissima*, which was present in the material from Lake Nyasa, and which is known from the plankton of several parts of Europe, was frequent, and *Sphinctosiphon polymorphus* is a new genus of the Palmellaceæ in which the mature colonies assume a vermiform character.

The Diatoms were relatively few in number, but included a few fine species of *Surirella*, such as *S. Füllebornii* and *S. Malombæ*, a large new species of *Cymatopleura* (*C. Nyansæ*, sp. n.), and several species of *Cyclotella* and *Melosira*.

The Myxophyceæ were poorly represented except for a few of the Chroococcaceæ. Two species I have considered to be new, *Lyngbya circumcreta* and *Dactylococcopsis africana*. Only a few fragments of a species of *Anabæna* were observed, but this may be due to the season of the year, as this genus was abundant in Tanganyika and Lake Nyasa later in the year.

Of the Peridinieæ, a curious reduced form of *Ceratium Hirundinella* was

rather scarce. The apical horn was very short and only two ant-apical horns were present.

From the examination of Dr. Cunnington's material collected in April, I agree with Schmidle's remarks upon Dr. Stuhlmann's collections which were made in October. The phytoplankton is essentially a Chlorophyceous plankton, and from the abundance of certain species of *Staurastrum*, it has all the features of a Desmid-plankton.

Phytoplankton of Tanganyika.—This lake is an elongated sheet of water lying between 3° and 9° S. lat. It has a length of 400 miles and a width varying between 10 and 45 miles. Its area is estimated at 14,000 square miles, and it is situated at 2700 ft. above sea-level. It is a deep lake, the southern end reaching a depth of 980 ft., and the northern end exceeding 1300 ft. in several places. The mean temperature of the water is stated to be 24·7° C. (76·6° F.).

Dr. Cunnington's collections of plankton extended from July 1904 to February 1905, and can be considered as fairly representative of eight consecutive months from July to February inclusive.

The phytoplankton is considerably richer as regards species than that of Lake Nyasa or Victoria Nyanza. The Chlorophyceæ are not particularly abundant, and, as in Lake Nyasa, Desmids are practically absent. In direct contrast to the phytoplankton both of Nyasa and Victoria Nyanza, *Pediastrum simplex* was very scarce and the genus *Cœlastrum* was quite absent. *Oocystis lacustris* was the most abundant of the Protococcoideæ, although *Scenedesmus quadricauda* was fairly general, and *Scenedesmus bijugatus* forma *arcuatus* was a feature of the October and November plankton. Other interesting species of the Protococcoideæ were *Crucigenia tetracantha*, sp. n., *Ankistrodesmus nitzschioides*, sp. n., *Cerasterias rhaphidioides*, Reinsch, and *Chodatella subsalsa*, Lemm. The latter is a brackish-water species which occurred in abundance in one of the November collections.

The Diatoms formed a large part of the phytoplankton throughout the whole eight months, and 25 of the species were not observed either in Nyasa or Victoria Nyanza. Eight species of *Navicula* were noted, two of which, *N. Tanganyikæ* and *N. distincta*, are new. The genus *Surirella* was represented by five species, of which three (*S. plana*, *S. obtusiuscula*, and *S. Tanganyikæ*) are new, and one of the others, *S. striatula*, is usually brackish or marine. A Diatom which I have considered to be identical with *Nitzschia nyassensis*, O. Müll., occurred in prodigious abundance from July to September, and in considerable quantity in the other months. The remaining Diatoms of importance were *Synedra actinastroides*, *S. Acus* var.? *revaliensis*, *Gyrosigma nodosum*, and *Cymbella grossestriata* var. *Tanganyikæ*.

The almost entire absence of Centric Diatoms is a noteworthy feature of

the Tanganyika collections, offering a marked contrast to the plankton of Nyasa and Victoria Nyanza, in which *Stephanodiscus*, *Cyclotella*, and *Melosira* abound. Only one species of *Cyclotella* was observed in the Tanganyika plankton and that very sparingly in the November collections.

Of the Myxophyceæ, two pelagic species of *Nostoc* (*N. piscinale* and *N. carneum*) were present in the August collections, and *Anabæna Flos-aquæ* var. *circularis* occurred in large quantity from October to February. So abundant was this *Anabæna* from October to December that the material taken from the tow-nets was of a dull blue-green colour although no spores had been developed. *A. Tanganyikæ*, a new, spirally-twisted species, only occurred in January and February. Four species of *Oscillatoria* were observed, one of which, *O. Tanganyikæ*, is a remarkable new species nearest to the marine *O. subuliformis*. Another new species of interest is *Spirulina laxissima*. The cells in the genus *Spirulina* are normally twisted into a rather close and narrow spiral, and the laxness of the twists in *S. laxissima* may be due to its adaptation to a pelagic existence.

The occurrence of *Plectonema Wollei*, Farlow, in the plankton is also worthy of note. This alga is not uncommon in the more aërated of the fresh waters of the tropics, but usually occurs attached to stones or large aquatic plants, especially in running water. Except for the very rare presence of false branches ("pseudo-rami"), this species appears to me to differ in no essential point from *Lyngbya majuscula*, Harvey, which is the largest of the marine species of *Lyngbya*. May not the presence or absence of false ramification be due to a difference of environment?

Eight species of the Chroococcaceæ were observed in the plankton of Tanganyika which were not observed from the other lakes.

Four species of the Peridinieæ occurred, all of which were most abundant from September to November, about the time of the maximum period of *Anabæna Flos-aquæ* var. *circularis*. *Peridinium africanum* and *Peridiniopsis Cunningtonii* have been described by Lemmermann as new species. *Glenodinium Pulvisculus* was particularly abundant in one of the November collections.

From a careful comparison of the collections there are slight indications that the plankton of this lake may not be uniform throughout. The constituents are probably not in the same proportions in different parts of the lake at the same time, and further observations will probably show that this is especially the case with regard to the relative dominance of *Anabæna Flos-aquæ* and *Synedra Acus* (together with *Nitzschia nyassensis*).

The following table contrasts the relative frequency of the various species observed in the collections from July 1904 to February 1905. "ccc" = very abundant, "cc" = common, "c" = fairly common, "r" = infrequent, "rr" = rare, and "rrr" = very rare.

Species.	1904.						1905.	
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Chlorophyceæ.								
Closterium Leibleinii, Kütz.	..	..	..	..	..	..	..	rr
Staurastrum alternans, Bréb.	..	..	..	..	rrr			
Hyalotheca mucosa, (Dillw.) Ehrenb.	..	..	rr					
Pediastrum simplex, Meyen	..	..	..	..	rr	..	..	rr
„ *duplex*, Meyen	..	..	..	..	..	..	..	r
„ *Boryanum*, (Turp.) Menegh.	..	..	..	rr	rr			
„ *Tetras*, (Ehrenb.) Ralfs	..	..	..	..	..	..	..	rr
„ *integrum*, Näg.	..	..	rrr	..	rrr			
Crucigenia tetracantha, sp. n.	..	..	..	..	..	..	..	rrr
Scenedesmus bijugatus, (Turp.) Kütz.	c	..	..	r				
„ „ forma *arcuatus*, (Lemm.) W. & G. S. West.	..	..	..	c	cc			
„ *acutiformis*, Schröder, var. *brasiliensis*, (Bohlin) W. & G. S. West.	..	..	..	r				
„ *quadricauda*, (Turp.) Bréb.	..	r	..	..	r	r	r	rr
„ „ var. *maximus*, W. & G. S. West.	..	..	..	r	rr	r	..	rr
Ankistrodesmus falcatus, (Corda) Ralfs, var. *spirilliformis*, G. S. West.	..	..	..	..	rr			
„ *nitzschioides*, sp. n.	..	..	..	..	rrr			
Tetraëdron minimum, (A. Br.) Hansg.	rrr							
Cerasterias rhaphidioides, Reinsch.	..	..	..	..	rrr			
Richteriella botryoides, (Schmidle) Lemm., forma *quadriseta*, (Lemm.) Chodat.	..	..	..	..	rrr			
Chodatella subsalsa, Lemm.	..	..	..	..	r			
Dictyosphærium pulchellum, Wood	..	..	..	..	r			
Tetracoccus botryoides, West	rr	..	..	rr	rr			
Botryococcus Braunii, Kütz.	..	..	..	..	..	c		
Glæocystis gigas, (Kütz.) Lagerh.	..	..	..	r				
Bacillarieæ.								
Cyclotella operculata, Kütz.	..	..	..	..	r			
Synedra Acus, Kütz.	..	..	cc	c	c	c		
„ „ var. *delicatissima*, (W. Sm.) Grun.	cc	c	c	ccc	ccc	c	c	
„ „ ? var. *revaliensis*, (Lemm.)	..	..	..	rrr	rr	r	c	c
„ *actinastroides*, Lemm.	cc	c	c	r	r	rr	rrr	
Cocconeis Pediculus, Ehrenb.	rr	r						
„ *Placentula*, Ehrenb.	..	..	r	r	c			
Navicula Tanganyikæ, sp. n.	..	rr	rr	..	r	..	..	rr
„ *elliptica*, Kütz.	..	..	..	r	r			
„ *Pupula*, Kütz.	..	rr	..	..	r	r	..	r
„ *bahusiensis*, Grun.	..	..	..	..	..	rrr		
„ *radiosa*, Kütz.	..	c	c	..	..	r		
„ *rhynchocephala*, Kütz.	..	r	r	..	r			
„ *distincta*, sp. n.	..	..	..	..	rr			
„ *Gastrum*, Ehrenb.	..	r	c	c	c	r		
Schizostauron Crucicula, Grun.	..	rr	..	rr	rr			
Gyrosigma attenuatum, (Kütz.) Cleve	..	..	..	..	r	..	rr	r
„ *nodiferum*, (Grun.) nob.	..	..	..	..	rrr			
Cocconema grossestriatum, (O. Müll.) nob., var. *Tanganyikæ*, var. n.	..	..	..	..	rr	rrr		
„ *cymbiforme*, Ehrenb.	..	..	r	rr				
Amphora ovalis, Kütz.	..	..	r	c	r	r	..	c

Species.	1904.						1905.	
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Amphora coffæiformis, (Ag.) Kütz.	..	..	..	rrr				
Epithemia turgida, (Ehrenb.) Kütz.	..	..	rrr	..	rr			
Rhopalodia gibba, (Kütz.) O. Müll., var. *ventricosa*, (Grun.) O. Müll.	..	rrr	..	c				
„ *hirudiniformis*, O. Müll.	c	..	..	r	r			
„ *gracilis*, O. Müll	rr	..	..	..	rr			
Nitzschia Tryblionella, Hantzsch, var. *littoralis*, (Grun.) Van Heurck.	..	..	rr					
„ *dissipata*, (Kütz.) Grun., var. *media*, Hantzsch.	..	..	..	rr				
„ *tubicola*, Grun.	rrr	..	..	..	rr			
„ *Palea*, (Kütz.) W. Sm.	..	..	r					
„ *nyassensis*, O. Müll.	cc	ccc	ccc	c	c			
Surirella plana, sp. n.	..	..	..	..	..	..	..	rr
„ *constricta*, Ehrenb., var. *africana*, O. Müll.	..	..	rr	rrr	rr			
„ *obtusiuscula*, sp. n.	..	..	..	rr	rr			
„ *Tanganyikæ*, sp. n.	..	r	r	..	r			
„ *striatula*, Turp.	..	..	..	..	..	..	rr	r
Cymatopleura Solea, (Kütz.) W. Sm.	..	r	..	rr	r	r	..	rr
Myxophyceæ.								
Nostoc piscinale, Kütz.	..	r						
„ *carneum*, Ag.	..	rr						
Anabæna Flos-aquæ, (Lyngb.) Bréb., forma	..	..	..	..	r	c		
„ „ var. *circularis*, var. n.	..	..	..	ccc	ccc	ccc	c	r
„ sp.? (fila rigidissima)	..	..	..	..	rr			
„ *Tanganyikæ*, sp. n.	..	..	..	..	..	..	r	cc
Plectonema Wollei, Farlow	rr	..	..	c				
Lyngbya perelegans, Lemm.	..	c	..	..	rr			
„ *limnetica*, Lemm.	c							
Phormidium tenue, (Ag.) Gomont	..	..	..	..	rr	..	..	r
„ *angustissimum*, W. & G. S. West	..	..	..	..	cc	rr	r	
Oscillatoria Princeps, Vauch.	..	rrr						
„ *Cortiana*, Menegh.	..	..	..	..	..	..	rrr	
„ *Tanganyikæ*, sp. n.	..	..	..	..	..	rr	..	r
„ *tenuis*, Ag.	..	..	rr					
Spirulina laxissima, sp. n.	..	..	..	..	c			
Glœotrichia natans, (Hedwig) Rabenh.	..	cc						
Merismopedia elegans, A. Br.	..	..	..	rrr				
„ „ var. *remota*, var. n.	..	..	..	..	..	..	..	rr
„ *æruginosa*, Bréb.	..	..	..	rr				
„ *glauca*, (Ehrenb.) Näg.	..	..	..	..	..	..	..	c
„ *punctata*, Meyen	..	..	..	..	rr			
Gomphosphæria aponina, Kütz.	cc	..	..	rr				
Microcystis elabens, (Bréb.) Kütz.	rr	..	rr					
Chroococcus turgidus, (Kütz.) Näg.	..	..	..	..	..	..	..	rrr
Peridinieæ.								
Glenodinium Pulvisculus, (Ehrenb.) Stein	..	..	r	r	cc			
Peridinium africanum, Lemm., sp. n.	..	..	..	..	r			
„ *berolinense*, Lemm., var. *apiculatum*, Lemm., var. n.	..	..	..	c	r			
Peridiniopsis Cunningtonii, Lemm., sp. n.	..	..	..	c	r			

It will be seen from the above table that the phytoplankton is richest in species in October and November, especially the latter month. In these months occur the maxima of *Scenedesmus bijugatus* f. *arcuatus*, *Synedra Acus* (and var. *delicatissima*), *Navicula Gastrum*, *Anabæna Flos-aquæ* (and var. *circularis*), *Phormidium angustissimum*, *Spirulina laxissima*, and *Glenodinium Pulvisculus*. In December there is a marked general decrease in the number of species. In January (the following month) the decrease in the Chlorophyceæ and Myxophyceæ is very noticeable, and concurrently a great quantity of *Nauplius*-larvæ appear in the plankton.

Plankton from the Lofu River.—This river runs into Tanganyika, and two tubes of plankton-material were collected from it by Dr. Cunnington in October 1904. The phytoplankton differs very much from that of Tanganyika, and the species bear much resemblance to those of the surrounding pools and swamps, from which they are doubtless recruited. Of the thirty species observed in this river-plankton only one occurred in the plankton of the lake itself.

The occurrence of *Sphærocystis Schroeteri*, Chodat, is very remarkable. This Alga is one of the most conspicuous features of the European freshwater phytoplankton, and is rarely found except in the plankton of lakes. No specimens were observed in the collections from Tanganyika itself, nor any from Lake Nyasa or Victoria Nyanza, but it was present in great abundance in the Lofu River and the specimens were exceedingly well developed.

The following species were observed :—

Chlorophyceæ.

Œdogonium, sp.
Myxonema subuligerum, (Kütz.) Hazen.
Ulothrix tenerrima, Kütz.
Mougeotia, sp.
Zygnema, sp.
Spirogyra, spp.
Gonatozygon monotænium, De Bary.
Closterium Venus, Kütz.
Pleurotænium subcoronulatum, (W. B. Turn.) W. & G. S. West.
,, *elatum*, (W. B. Turn.) Borge, var. *conjunctum*, (W. B. Turn.) W. & G. S. West.
Euastrum denticulatum, (Kirchn.) Gay.
Micrasterias americana, (Ehrenb.) Ralfs.
Cosmarium Pseudobroomei, Wolle.
,, *Blyttii*, Wille.
,, *binum*, Nordst.
,, *margaritatum*, (Lund.) Roy. & Biss.
,, *nitidulum*, De Not.

Hyalotheca mucosa, (Dillw.) Ehrenb.
Scenedesmus denticulatus, Lagerh., var. *linearis*, Hansg.
„ *obliquus*, (Turp.) Kütz.
Ankistrodesmus falcatus, (Corda) Ralfs.
Sphærocystis Schroeteri, Chodat.

Bacillarieæ.

Synedra Ulna, (Nitzsch) Ehrenb.
„ „ var. *splendens*, (Kütz.) Van Heurck.
Achnanthes linearis, (W. Sm.) Grun.
Vanheurckia vulgaris, (Thw.) Van Heurck.
Gomphonema parvulum, (Kütz.) Grun.
Cocconema gracile, (Rabenh.) G. S. West.
„ *læve*, (Näg.) nob.
Surirella robusta, Ehrenb., var. *splendida*, (Ehrenb.) Van Heurck.

Myxophyceæ.

Lyngbya bipunctata, Lemm.

III SYSTEMATIC ACCOUNT OF THE ALGÆ OF THE COLLECTIONS.

This portion of the paper is devoted to a complete systematic account of all the Algæ observed in Dr. Cunnington's collections, those from pools and swamps, from scrapings of wet rocks, &c., being included along with the plankton. The collections from Tanganyika and the vicinity were the most numerous, and this fact accounts largely for the greater number of species recorded from that area. The few collections from the vicinity of Victoria Nyanza contained a relatively greater variety of Algæ, and had more collections been made in the area, a very rich Alga-flora would undoubtedly have been revealed.

The absence of plants belonging to the Stigonemaceæ is somewhat remarkable, the genus *Nostochopsis* being the only representative of the family observed. Species of *Hapalosiphon* are of general occurrence in the swamps and marshes of the tropics, not to mention certain of the bog-loving and rupestral *Stigonema*, and four species of the first-mentioned genus have already been recorded from Tropical Africa.

Several of the Algæ observed have been excluded from this account owing to the impossibility of identifying them with any degree of certainty. Such species were mostly in a fragmentary condition, and amongst them were two species of *Nostoc* from the Tanganyika area, a species of *Calothrix* from Deep Bay, Nyasa, and a *Batrachospermum* from the Lofu River, Tanganyika.

One genus, thirty-six species, and eighteen varieties and forms are here described for the first time.

The Peridinieæ have been examined, and the new forms described, by Mr. E. Lemmermann of Bremen, to whom I offer my best thanks for his kindly assistance on this as on other occasions, with this group of flagellate organisms.

Class CHLOROPHYCEÆ.

Order ŒDOGONIALES.

Family ŒDOGONIACEÆ.

Genus ŒDOGONIUM, *Link.*

1. Œdogonium cryptoporum, *Wittr. Dispos. Œdog. Suec.* (1870) p. 19; *Prodr. Monog. Œdog.* (1874) p. 7.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

2. Œdogonium Hirnii, *Gutw. in Rospraw. matem.-przy. Akad. Umiej. Krakow.* xxxii. (1897) p. 2, t. 5. fig. 1; *Hirn, in Act. Soc. Sci. Fennicæ*, xxvii. (1900) p. 93, t. 5. fig. 29.

Crass. cell. veget.	11–13 μ;	altit.	4–5-plo major;
,, oogon.	34–37 μ;	,,	37–40 μ;
,, oospor.	30–31 μ;	,,	30–31 μ;
,, cell. antherid....	11 μ;	,,	7– 8·5 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

This species has previously been observed only in Galicia and Ireland.

Var. africanum, var. n.

Var. cellulis vegetativis leviter crassioribus et brevioribus, levissime capitellatis; oogoniis paullo majoribus; antheridiis 3-cellularibus.

Crass. cell. veget.	13–15 μ;	altit.	2½–3-plo major;
,, oogon.	39–40 μ;	,,	38 μ;
,, oospor.	33–34 μ;	,,	33–34 μ;
,, cell. antherid....	13–13·5 μ;	,,	5– 6 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

3. Œdogonium dictyosporum, *Wittr. Prodr. Monogr. Œdog.* (1874) p. 13; *Hirn, l. c.* p. 103, t. 7. fig. 43.

Forma oogoniis et oosporis ovato-ellipsoideis, paullo majoribus.

Crass. cell. veget.	14–16 μ;	altit.	3–5-plo major;
,, oogon.	42 μ;	,,	52 μ;
,, oospor.	40 μ;	,,	50 μ;
,, cell. antherid....	13 μ;	,,	8–9 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

4. **Œdogonium Kurzii**, *Zeller, in Hedwigia*, xii. (1873) p. 189; *Hirn, in Act. Soc. Sci. Fennicæ*, xxvii. (1900) p. 135, t. 16. fig. 93.

Crass. cell. veget.	47–51 μ;	altit. 2–5-plo major;
„ oogon.	78–90 μ;	„ 111–121 μ;
„ oospor.	75–86 μ;	„ 80– 90 μ;
„ cell. antherid....	44–50 μ;	„ 6– 16 μ.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

This interesting species was in fine fruiting condition. It has only previously been found in the Pegu province of E. India. Hirn states that the number of cells composing the antheridia may be as many as six. In the African specimens four or five was the usual number, but some of the antheridia were composed of as many as 15 cells. The hypogynous position of the antheridia was very characteristic.

5. Œdogonium Kitutæ, sp. n.

Œ. dioicum, nannandrium; oogoniis singulis vel binis, subglobosis vel obovato-globosis, poro superiore apertis; oosporis globosis, oogonia non complentibus, membrana glabra; cellulis suffultioriis tumidis; androsporangiis . . . . . ? cellula terminali obtusa; nannandribus elongatis, leviter curvatis, oblongis, inferne angustioribus, in cellulis suffultioriis et oogoniis sedentibus, antheridio interiori (?).

Crass. cell. veget.	26 μ;	altit. 5–7-plo major;
„ oogon.	76–78 μ;	„ 75–80 μ;
„ oospor.	72 μ;	„ 72 μ;
„ cell. suffult. ...	44 μ;	„ 3-plo major;
„ nannandr.	12–13 μ;	„ 58–66 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

No examples of this species were observed in which the antheridia were fully formed, but from the structure of the dwarf-males (nannandria) there can be little doubt that they are internal in development. The only diœcious nannandrous species in which the antheridia are developed internally within the dwarf-males, and which can be compared with *Œ. Kitutæ* in respect of size of vegetative cells and form of oogonia and oospores, are *Œ. alternans*, Wittr. & Lund., *Œ. cataractum*, Wolle, and *Œ. cyathigerum*, Wittr.

Œ. Kitutæ differs from *Œ. alternans* in the smaller size of its vegetative cells, which are more elongated, and in the oospores not filling the oogonia. The oogonia are also much less numerous than in *Œ. alternans*, and they are only found singly or in pairs near the ends of the filaments.

From *Œ. cyathigerum* it is distinguished by its relatively larger and differently-shaped oogonia and oospores, the latter being destitute of the longitudinal costæ.

It should also be compared with *Œ. Borisianum*, (Le Clerc) Wittr., from

which it differs in its slightly thicker vegetative cells, its larger oogonia and oospores, and in its internal antheridia. The oogonia are developed in a very similar manner and in the same part of the filament as those of *Œ. Borisianum.*

NOTE.—Sterile species of *Œdogonium* were observed from the following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18); in swamp, Karonga (2 July, 1904; no 34); small sp. with capitellate cells in the plankton of Monkey Bay (17 June, 1904; no. 15), and off Vahambwera Point (24 June, 1904; no. 24).—**Tanganyika.** In swamp, Kituta (23 Aug. 1904; no. 72): on surface of swampy pond, Mrumbi (27 Dec. 1904; no. 195); in the plankton of Lofu River (5 Oct. 1904; no. 124).

Genus BULBOCHÆTE, *Ag.*

6. BULBOCHÆTE ELATIOR, *Pringsh. Jahrb.* i. p. 73 (1858); *Hirn, in Act. Soc. Scient. Fennicæ*, xxvii. (1900) p. 321, t. 51. fig. 327.

Crass. cell. veget.	14–17 μ;	altit.	2–3-plo major;
„ oogon.	41–43 μ;	„	36–38 μ;
„ cell. androsp. ...	12 μ;	„	9 μ;
„ stip. nannandr..	8 μ;	„	23 μ;
„ cell. antherid....	7 μ;	„	11 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

NOTE.—Sterile species of *Bulbochæte* were observed from the two following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18).—**Tanganyika.** Surface of swamp, Toa (10 Jan. 1905; no. 208).

Order CHÆTOPHORALES.

Family **ULOTRICHACEÆ.**

Genus ULOTHRIX, *Kütz.*

7. ULOTHRIX TENERRIMA, *Kütz. Phyc. Germ.* (1845) p. 253, t. 9. fig. 1; *Sp. Alg.* (1849) p. 346; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 366; *Hazen, in Mem. Torr. Bot. Club*, xi. no. 2 (1902) p. 151, t. 21. figs. 3, 4.

Crass. fil. 7·5–8·5 μ; cellulis diametro 1–1¾-plo longioribus.

Tanganyika.—In plankton, surface of Lofu River (5 Oct. 1904; no. 124).

Genus URONEMA, *Lagerh.*

8. URONEMA CONFERVICOLUM, *Lagerh. in Malpighia* (1887), p. 518, t. 12. figs. 1–10.

Crass. fil. 4·5–6·5 μ.

Victoria Nyanza.—Among *Utricularia* in swampy pool near Bukoba (20 Aug. 1905 ; no. 618).

Tanganyika.—Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

Family **CHÆTOPHORACEÆ.**

Genus CHÆTOPHORA, *Schrank.*

9. ? Chætophora elegans, (*Roth*) *Ag. Dispos. Alg. Suec.* 42 (1812) ; *Cooke, Brit. Freshw. Alg.* (1883) p. 194, t. 78. fig. 2.

Crass. cell. 3·5–5·5 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 123) ; in small gelatinous masses among *Myxonema subuligerum*. The specimens were insufficient for accurate identification.

Genus MYXONEMA, *Fries*, 1825.

10. Myxonema subuligerum, (*Kütz.*) *Hazen, in Mem. Torr. Bot. Club*, xi. (1902) p. 200, t. 30.—Stigeoclonium subuligerum, *Kütz. Sp. Alg.* (1849) p. 354 ; *Tab. Phyc.* iii. (1853) t. 5. fig. 1.

Crass. fil. prim. 14·5–16 μ ; crass. ram. circ. 6–10 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; nos. 123 and 124)

Order CLADOPHORALES.

Family **CLADOPHORACEÆ.**

Genus CHÆTOMORPHA, *Kütz.*

11. Chætomorpha Linum, *Kütz. Phyc. Germ.* (1845) p. 204 ; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 327.—Conferva Linum, *O. F. Müll.* Chætomorpha sutoria, *Berk.*

Crass. fil. 108–161 μ ; crass. membr. cell. 6–8 μ.

Tanganyika.—Dredged from a few fathoms, Niamkolo Bay (3 Aug. 1904 ; no. 40). Floating on the surface, Kituta Bay (26 Aug. 1904 ; no. 79).

Genus CLADOPHORA, *Kütz.*

12. Cladophora fracta, (*Dillw.*) *Hass. Brit. Freshw. Alg.* (1845) p. 216, t. 55 ; *Kütz. Sp. Alg.* (1849) p. 410.—C. fracta *a.* fracta normalis, *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 334.

Forma FLOTOWIANA, (*Kütz.*) *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 335.

Crass. fil. prim. 80–102 μ ; crass. ram. 65–70 μ ; crass. ramul. 25–32 μ.

Tanganyika.—Scraped from the bottom of Dr. Cunnington's "dau" (24 Jan. 1905 ; no. 216).

The branches of the first order were somewhat patent and subdichotomously branched ; those of the second order (ramuli) were short, often papilliform and unicellular, or even merely curved (subuncinate) outgrowths from the upper extremities of the cells of branches of the first order.

13. CLADOPHORA CRISPATA, (*Roth*) *Kütz. Phyc. Gen.* (1843) p. 264; *Rabenh. l. c.* p. 336 ; *Cooke, Brit. Freshw. Alg.* p. 143, t. 55. fig. 3.

Tanganyika.—Growing on grass-stems close to the shore, Kituta Bay (23 Aug. 1904 ; no. 73).

Forma parva, parce ramosa, articulis diametro 5–12-plo longioribus ; cytiodermate crasso, distincte plicato-striato.

Crass. fil. prim. 48–58 μ ; crass. ram. 23–27 μ.

Nyasa.—Dredged in three fathoms, growing on bivalve shells, Anchorage Bay (no. 11).

Forma parva, rigida, parce ramosa, filis usque ad 2·5 cm. longis.

Cross. fil. prim. 95–104 μ ; crass. ram. 30–64 μ.

Victoria Nyanza.—Growing on rocks just below the water-level, Bukoba (17 Apr. 1905 ; no. 247).

14. CLADOPHORA CANALICULARIS, (*Roth*) *Kütz. Sp. Alg.* (1849) p. 109 *Rabenh. l. c.* p. 342.

Forma CAPITELLATA.

Forma parva, usque ad 2 cm. alta, ramosissima, ramis basi connatis; articulis diametro 4–8-plo longioribus, distincte capitellatis, ad genicula plus minusve constrictis.

Crass. fil. prim. 26–34 μ ; crass. ram. 18–24 μ.

Nyasa.—On rocks at water-level, Deep Bay (25 June, 1904 ; no. 26).

Tanganyika.—Scraped from the bottom of Dr. Cunnington's "dau" (24 Jan. 1905 ; no. 217).

15. CLADOPHORA BRACHYSTELECHA, *Rabenh. Alg. Sachs.* no. 654 (1862) ; *Fl. Europ. Alg.* iii. (1868) p. 343.

Fila usque ad 4 mm. alta, densissime radiata circa culmos vetustos pelagios, ramosissima ; ramis divaricatis et intricatis ; articulis diametro 5–11-plo longioribus.

Crass. fil. prim. 50–64 μ ; crass. ram. et ramul. 27–35 μ.

Tanganyika.—Thickly covering floating fragments of stems collected in the tow-nets off Niamkolo Island (29 July, 1904 ; no. 36).

16. Cladophora inconspicua, sp. n.

C. pallide viridis, minuta, calce partim incrustata, in lapidibus litoris erosis; cæspitibus 1–3 mm. alta, valde et dichotome ramosa, ramis sursum subdichotome ramulosis, ramis et ramulis plerumque crassitudine æqualibus, insertione ramorum laterali vel apicali; cellulis (fil. prim., ramorum, et ramulorum) diametro 3½–8½-plo longioribus; cellula apicali ramorum mucronata; membrana firma et subcrassa.

Crass. fil. prim. 50–56 μ; crass. ram. et ramul. 18–40 μ; crass. ramul. ult. 12–15 μ.

Tanganyika.—On stones, dredged in a few fathoms, Niamkolo.

The pebbles on which this *Cladophora* was growing were coated with a deposit of lime about 4–5 mm. in thickness, the surface of which was much eroded, and the minute tufts of the Alga occupied the numerous irregular depressions and holes covering the exposed surface of the incrustation. The pebbles were of a flinty nature, consisting of dark-coloured impure silica, and the outer incrustation of lime containing the hollows was of a brownish-yellow colour and much pitted. The actual thallus of the *Cladophora* is not incrusted with lime except at the extreme basal portions. The pebbles presented much the same appearance as those described by Chodat from the lakes of the Jura.

Cladophora inconspicua is probably the smallest described species of the genus. The thallus is much branched, the branching being mostly dichotomous. The tufts are very dense, and the basal part of the thallus is firmly attached to the stone by colourless rhizoids, which frequently branch and become somewhat irregular in outline. Some of the branches of the first order terminate in cylindrical apical cells with a mucronate apex, whereas the apical cells of the smaller branches are generally narrower and considerably attenuated to a blunt extremity.

Among the basal portions of the *Cladophora*, in the eroded cavities of the stones, were numerous thalli of *Palmophyllum foliaceum*, sp. n., and attached to the branches of the *Cladophora*, especially the younger ones, were quantities of *Calothrix brevissima* forma.

17. Cladophora sp.

C. filis di(vel 3–4)-chotoma, ramosissima, ad 6 mm. altis, ramulis brevibus et fasciculatis, articulis diametro 3–7-plo longioribus.

Crass. fil. prim. usque ad 130 μ; crass. ram. 24–34 μ.

Tanganyika.—Growing on stones, shells, submerged roots and grasses, Niamkolo (1 Aug. 1904; no. 44). Probably the same plant but less branched, with quantities of sand among the branches, attached to shells dredged in about 10 fathoms, Mtondwe Bay (2 Sept. 1904; no. 83).

Order CONJUGATÆ.

Family ZYGNEMACEÆ.

Subfam. MESOCARPEÆ.

Genus MOUGEOTIA, *Ag.*

A number of sterile species of this genus were observed, principally from the Tanganyika region. No trace of spore-formation was observed in any of them.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

Subfam. ZYGNEMEÆ.

Genus DEBARYA, *Wittr.*

18. DEBARYA AFRICANA, sp. n. (Pl. **5.** figs. 3–4.)

D. cæspitibus laxe intricatis, cellulis vegetativis diametro 4–8-plo longioribus, pyrenoidibus 5–8 in chromatophora unoquoque; zygosporis ubi conjugatione scalariformi productis, globoso-ellipsoideis, magnis, tubo conjugatione complentibus et in gametangiis immersis, axe longiore transverse disposito; membrana zygosporæ glabra; membrana gametangiorum subcrassa; gametangiis sæpe tortis.

Crass. cell. veget. 23–26 μ; lat. zygosp. 56 μ; long. zygosp. 50 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

As in other species of *Debarya* the gametangia undergo a change subsequent to conjugation. In this case the cell-walls increase considerably in thickness, and during this process a narrow pit arises in the middle of each transverse wall (*vide* Pl. **5.** fig. 4). The zygospore is large and occupies the whole of a greatly swollen conjugating-tube, extending on each side to the outer walls of the gametangia.

D. africana is nearest to *D. immersa*, W. West (*Mougeotia immersa*, W. West, in Journ. Bot. xl. (1902) p. 144), a species only known from India, but is distinguished by its much longer vegetative cells, its larger, smooth, and more completely immersed zygospores, and by the thickened walls of the gametangia.

Genus ZYGNEMA, *Ag.*

Sterile species were observed from:—

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

Genus SPIROGYRA, *Link.*

19. Spirogyra sp. ad *S. longatam*, (Vauch.) Wittr. accedens.

The zygospores were not mature and the specimens were scarcely in a condition for accurate description.

Crass. cell. veget. 34–38 μ; long. zygosp. immatur. 72 μ, lat. 53 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

20. Spirogyra porticalis, (*Vauch.*) *Cleve, in Nov. Act. R. Soc. Sci. Upsal.* ser. 3. vi. no. 11 (1868), p. 22; *Petit, Spirog. Environs Paris* (1880), p. 21, t. 5. figs. 8–12.

Var. africana, var. n.

Var. cellulis fructiferis leviter tumidis; cellulis vegetativis et chromatophoris singulis ut in forma typica; zygosporis paullo majoribus, oblongo-ellipticis, mesosporio plicato-ruguloso.

Crass. cell. veget. 40–41 μ; long. zygosp. 93 μ, lat. 58 μ.

Nyasa.—Among weeds and various Algæ, in swamp, Karonga (2 July, 1904; no. 34).

21. Spirogyra æquinoctialis, sp. n. (Pl. **5.** figs. 1–2.)

S. cellulis vegetativis diametro circiter 4–6-plo longioribus, extremitatibus non replicatis; chromatophoris 3 (interdum 2), subcrassis, marginibus irregulariter undulatis, anfractibus $1–1\frac{1}{2}$, cum pyrenoidibus magnis; conjugatione scalariformi, cellulis fructiferis inflatis et suboblongo-rectangularibus; zygosporis oblongo-ellipticis, ovoideis, vel oblongo-ovoideis, diametro circiter $1\frac{1}{4}–1\frac{4}{5}$-plo longioribus; membrana zygosporæ crassa, lamina mediana dense scrobiculata.

Crass. cell. veget. 23–25 μ; crass. cell. fructif. (♀) 41·5–43 μ; long. zygosp. 52–71 μ, lat. 41–43 μ; crass. membr. zygosp. 4 μ.

Nyasa.—Growing on stones, &c., on the shore, Domira Bay (19 June, 1904; no. 17).

The zygospores are mostly oblong-elliptic in form, with brown walls of considerable thickness, the middle coat of which is densely and markedly scrobiculate. They fill up the fructiferous cells transversely, being closely applied to the swollen walls of the female gametangia. The chloroplasts are most commonly three (sometimes only two) in each cell, with nodulose or undulate margins and large pyrenoids.

It stands nearest to another tropical species, *S. Schmidtii*, W. & G. S. West (Freshw. Alg. Koh Chang, in Bot. Tidsskr. xxiv. (1901) p. 161, t. 4. figs. 43–45), but is distinguished by its thinner vegetative filaments with shorter cells, by the shorter and more oblong zygospores, and by the oblong form of the inflated fructiferous cells.

22. Spirogyra decimina, (*Müll.*) *Kütz. Phyc. Germ.* (1845) p. 223; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 242; *Petit, Spirog. Env. Paris*, 1880, p. 25, t. 8. figs. 1–3.

Crass. cell. veget. 32–36 μ; long. zygosp. 65–68 μ; lat. zygosp. 37–39 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; nos. 32 and 33).

Forma cellulis crassioribus et zygosporis sæpe diametro duplo longioribus.

Crass. cell. veget. 42–54 μ; long. zygosp. 68–124 μ; lat. zygosp. 47–50 μ.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

Forma tropica [*S. decimina*, forma, W. & G. S. West, in Bot. Tidsskr. xxiv. (1901) p. 161].

Forma major, cellulis vegetativis diametro $2\frac{1}{2}$–5(usque 6)-plo longioribus; cellulis fructiferis non inflatis; chromatophoris 3, cum marginibus asperis, anfractibus $2\frac{1}{2}$–$4\frac{1}{2}$.

Crass. cell. veget. 46–52 μ; long. zygosp. 72–92 μ; lat. zygosp. 46–50 μ.

Nyasa.—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

Precisely the same form has been observed from Koh Chang in the Gulf of Siam.

Very near to these tropical forms of *S. decimina*, and most probably identical with them, is a species described by Schmidle as *S. Fülleborni* (*vide* Engl. Bot. Jahrb. xxxii. (1903) p. 76, t. 3. fig. 2). The thickness of the vegetative cells is the same, there are three spirals in each case, and the size and form of the zygospores are the same. Schmidle's plant was described from the vicinity of Nyasa.

23. Spirogyra neglecta, (*Hass.*) *Kütz. Sp. Alg.* (1849) p. 441; *Rabenh. l. c.* p. 248; *Petit, l. c.* p. 26, t. 9. figs. 1–5.—Zygnema neglecta, *Hass.*

Var. ternata, (*Ripart*) *W. & G. S. West, in Journ. Bot.* xxxv. (1897) p. 41.—S. ternata, *Ripart, in Bull. Soc. Bot. Fr.* xxiii. (1876) p. 162; *Petit, l. c.* p. 26, t. 8. figs. 4–7.

Crass. cell. veget. 52–59 μ; long. zygosp. 74–78 μ; lat. zygosp. 52–53 μ.

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904; no. 196).

24. Spirogyra nitida, (*Dillw.*) *Link, Handb.* iii. (1833) p. 262; *Kütz. l. c.* p. 442; *Petit, l. c.* p. 28, t. 10. figs. 6–10.

Crass. cell. veget. 80–85 μ; long. zygosp. 105–148 μ; lat. zygosp. 55–84 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

25. Spirogyra bellis, (*Hass.*) *Cleve, in Nov. Act. R. Soc. Sci. Upsal.* ser. 3, vi. no. 11 (1868), p. 18; *Petit, l. c.* p. 31, t. 10. figs. 1–3.

Var. minor, var. n.

Var. cellulis angustioribus et zygosporis minoribus. Crass. cell. veget. 56–58 μ; diam. zygosp. 44–56 μ.

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904; no. 196).

NOTE.—Sterile species of *Spirogyra* were observed from the following localities:—**Nyasa.** In swamp, Kota Kota (20 June, 1904; no. 18). In pools, on shore, Nkata Bay (23 June, 1904; no. 22). Among weeds, in swamp, Karonga (2 July, 1904; no. 34).—**Tanganyika.** In swamp, Mbete (28 Sept. 1904; no. 108). In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124); this was a large species, similar to *S. crassa*, Kütz.; crass. veg. cell. 114–132 μ; diam. zygosp. immatur. 100–104 μ.

A fact of some interest is the complete absence from the collections of any species of *Spirogyra* with replicate extremities to the vegetative cells.

Family **DESMIDIACEÆ.**

Subfam. SACCODERMÆ.

Genus GONATOZYGON, *De Bary.*

26. GONATOZYGON MONOTÆNIUM, *De Bary, in Rabenh. Alg.* (1856) no. 539; *W. & G. S. West, Brit. Desm.* i. (1904) p. 30, t. 1. figs. 1–7.—G. Ralfsii, *De Bary, Conj.* (1858) p. 76, t. 4. figs. 23–25.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

27. GONATOZYGON KINAHANI, (*Arch.*) *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 156; *W. & G. S. West, l. c.* p. 35, t. 2. figs. 1–3.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Victoria Nyanza.—In swampy pool, near Bukoba (20 Apr. 1905; no. 618).

Genus CYLINDROCYSTIS, *Menegh.*

28. CYLINDROCYSTIS SUBPYRAMIDATA, *W. & G. S. West, in Bot. Tidsskr.* xxiv. (1901) p. 162, t. 2. figs. 8–11.

Long. 26–29 μ; lat. 16–18 μ; lat. constrict. 15–16 μ.

Victoria Nyanza.—In swampy pool, Bukoba (20 Apr. 1905; no. 618).

Tanganyika.—Among weeds, mouth of Malagarasi River (16 Jan. 1905 no. 611).

Genus NETRIUM, *Lütkem.*

29. NETRIUM DIGITUS, (*Ehrenb.*) *Itzigs. & Rothe, in Rabenh. Alg.* no. 508 (1856); *W. & G. S. West, Brit. Desm.* i. (1904) p. 64, t. 6. figs. 14–16.—Penium Digitus, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 150, t. 25. fig. 3.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Forma parva et angustior: long. 112–140 μ; lat. 27–32 μ.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1906; no. 251).

Tanganyika.—In swamps, Kituta (26 Aug. 1904; no. 80).

Subfam. PLACODERMÆ.

Genus PENIUM, *Bréb.*

30. PENIUM NAVICULA, *Bréb. in Mém. Soc. Sci. Nat. Cherb.* iv. (1856) p. 146, t. 2. fig. 37; *W. & G. S. West, Brit. Desm.* i. (1904) p. 75, t. 7. figs. 12–15.

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618).

31. PENIUM AUSTRALE, *Racib. in Rospraw. matem.-przy. Akad. Umiej. Krakow.* ser. 2, xxii. (1892) p. 367, t. 6. fig. 27; *W. & G. S. West, in Journ. Linn. Soc., Bot.* xxxiii. (1897) p. 157, t. 8. fig. 16; *in Bot. Tidsskr.* xxiv. (1901) p. 163.

a. Forma brevior: long. 55–57 μ; lat. 36–38 μ; lat. isthm. 35–36 μ. (Pl. **6**. fig. 3.)

Victoria Nyanza.—Near the shore, Bukoba (20 Apr. 1905; no. 251).

b. Forma crassior: long. 72 μ; lat. 51 μ; lat. isthm. 48 μ. (Pl. **6**. fig. 4.)

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618.)

Genus CLOSTERIUM, *Nitzsch.*

32. CLOSTERIUM LAGOENSE, *Nordst. in Vidensk. Medd. f. d. Naturh. Foren. Kjöb.* (1870) p. 203, t. 2. fig. 2.

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

33. CLOSTERIUM NEMATODES, *Josh. in Journ. Linn. Soc., Bot.* xxi. (1886) p. 652, t. 22. figs. 7–9.

Var. TUMIDUM, var. n. (Pl. **6**. fig. 2.)

Var. cellulis paullo tumidis ad medium marginis ventralis, polis obtusioribus, striis validioribus.

Long. 190 μ; lat. 27 μ; lat. apic. 10 μ.

Victoria Nyanza.—Near the shore of the lake, Bukoba (20 Apr. 1905; no. 251).

The apices of this variety are more obtuse than in the typical form, and the ventral margin of the cell is distinctly tumid, giving it a stouter appearance.

34. CLOSTERIUM PARVULUM, *Näg. Gatt. einz. Alg.* (1849) p. 106, t. 6 C. fig. 2 (ex parte); *W. & G. S. West, Brit. Desm.* i. (1904) p. 133, t. 15. figs. 9–12.

Small forms: lat. 11 μ; apicibus 105 μ inter se distantibus.

Nyasa.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

Victoria Nyanza.—In swamp pool near Bukoba (20 Apr. 1905; no. 618).

35. CLOSTERIUM JENNERI, *Ralfs, Brit. Desm.* (1848) p. 167, t. 28. fig. 6; *W. & G. S. West, l. c.* p. 134, t. 15. figs. 23–25.

Lat. 11–13 μ; apicibus 82–91 μ inter se distantibus.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

36. Closterium Venus, *Kütz. Phyc. Germ.* (1845) p. 130; *W. & G. S. West, Brit. Desm.* i. (1904) p. 137, t. 15. figs. 15–20.

Lat. 8·5 μ; apicibus 72 μ inter se distantibus.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123).

37. Closterium Leibleinii, *Kütz. in Linnæa*, viii. (1833) p. 596; *W. & G. S. West, l. c.* p. 141, t. 16. figs. 9–14.

Nyasa.—Among Algæ growing on stones, Domira Bay (19 June, 1904; no. 17). Among *Utricularia*, Domira Bay (19 June, 1904; no. 579).

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108). In plankton, Baraka (24 Feb. 1905; no. 240).

38. Closterium moniliferum, (*Bory*) *Ehrenb. Infus.* p. 91 (1838); *Ralfs, Brit. Desm.* (1848) p. 166, t. 28. fig. 3; *W. & G. S. West, l. c.* p. 142, t. 16. figs. 15, 16.

Var. galiciense, (*Gutw.*) nob. Closterium galiciense, *Gutw. in Rospraw. matem.-przy. Akad. Umiej. Krakow.* (1896), p. 39, t. 6. fig. 18.

Long. 248–294 μ; lat. 44–47 μ; lat. apic. 11–12 μ.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

The African plants possessed a smooth and colourless cell-wall, and agreed perfectly in size and general proportions with Gutwinski's Galician examples. The distinctive features from typical *C. moniliferum* are the thickened apices of the cells and the reduced ventral inflation.

39. Closterium acerosum, (*Schrank*) *Ehrenb. Infus.* p. 92 (1838); *Ralfs, Brit. Desm.* (1848) p. 164, t. 27. fig. 2; *W. & G. S. West, l. c.* p. 146, t. 18. figs. 2–5.

Nyasa.—Among other Algæ on the shore, Domira Bay (19 June, 1904; no. 17). Among *Utricularia*, Domira Bay (19 June, 1904; no. 579.)

Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208.)

40. Closterium tumidum, *Johnson, in Bull. Torr. Bot. Club*, xxii. (1895) p. 291, t. 239. fig. 4; *W. & G. S. West, l. c.* p. 156, t. 19. figs. 15–18.

Rather stout forms: long. 116–142 μ; lat. 19–20 μ; lat. apic. circ. 5 μ.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

41. Closterium gracile, *Bréb. List Desmid.* p. 155 (1856); *W. & G. S. West, l. c.* p. 166, t. 21. figs. 8–12.

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

Var. TENUE, (*Lemm.*) *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* vi. (1902) p. 138, t. 18. figs. 22, 23.—C. limneticum, *Lemm.*, var. tenue, *Lemm.*

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

42. CLOSTERIUM ACUTUM, (*Lyngb.*) *Bréb. in Ralfs, Brit. Desm.* (1848) p. 177, t. 30. fig. 5, t. 34. fig. 5 *a*, *b*, *d–f*; *W. & G. S. West, Brit. Desm.* i. (1904) p. 177, t. 23. figs. 9–14.

Lat. cell. 4–4·5 μ; long. zygosp. 32 μ; lat. max. zygosp. 18 μ.

Nyasa.—Among *Utricularia*, swampy margin of lake, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In swamp, Kituta, with zygospores (26 Aug. 1904; no. 80).

43. CLOSTERIUM RALFSII, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 17; *Ralfs, l. c.* p. 174, t. 30. fig. 2; *W. & G. S. West, l. c.* p. 182, t. 24. figs. 6, 7.

Var. HYBRIDUM, *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 135; *W. & G. S. West, l. c.* p. 183, t. 24. figs. 8–13.

Forma paullo crassior: long. 302–332 μ; lat. 42–45 μ; lat. apic. 9–10 μ.

Victoria Nyanza.—In pools near the shore, Bukoba (20 Apr. 1905; no. 251).

The specimens were rather broader than is usual for this frequent tropical *Closterium*, and in this respect they resembled a plant described by Gutwinski as *C. Wagæ* (*vide* Rospraw. matem.-przyr. Akad. Umiej. Krakow. 1896, p. 40, t. 2. fig. 20). The apices were also somewhat angular. It seems probable that *C. Wagæ* is only an extreme shortened form of *C. Ralfsii* var. *hybridum*.

Genus PLEUROTÆNIUM, *Näg.*

44. PLEUROTÆNIUM CORONATUM, (*Bréb.*) *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 143; *W. & G. S. West, l. c.* p. 199, t. 27. figs. 16–18, t. 28. fig. 4.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; nos. 72 and 80).

45. PLEUROTÆNIUM SUBCORONULATUM, (*W. B. Turn.*) *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 44, t. 5. f. 33.

Var. DETUM, *W. & G. S. West, l. c.* (1896) p. 235, t. 13. figs. 2, 3.

Long. 460 μ; lat. ad bas. semicell. 40 μ, ad apic. 35 μ.

Victoria Nyanza.—Among *Utricularia* in swampy pool near Bukoba (20 Apr. 1905; no. 618).

Borge has observed specimens from Brazil in which only one semicell possessed the infra-apical constriction (*vide* Arkiv för Botanik, K. Sv. Vet.-Akad., Bd. i. (1903), p. 82). The curious ligature-like constriction of this variety was well marked in the examples from Victoria Nyanza, but it is possible that it is only a variation due to inequality of growth.

46. PLEUROTÆNIUM ELATUM, (*W. B. Turn.*) *Borge, in Bih. K. Sv. Vet.-Akad. Handl.* xxiv. (1899) Afd. 3, no. 12, p. 16.—Docidium elatum, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 27, t. 2. fig. 16. Docidium robustum, *W. B. Turn. l. c.* p. 27, t. 2. fig. 8.

Var. CONJUNCTUM, (*W. B. Turn.*) *W. & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* vi. (1902) p. 144.—Docidium conjunctum, *W. B. Turn. l. c.* p. 32, t. 4. fig. 6.

Long. 530–561 μ; lat. ad bas. semicell. 45–48 μ; lat. apic. 40–42 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

The individuals observed were slightly larger than Turner's measurements of *P. elatum* var. *conjunctum*, but not so large as the forma *duplo-major* described from Ceylon. The lateral margins of the semicells were slightly undulate from base to apex, and each apex possessed 26–27 tuberculi. The individuals remained attached by their apices, and filaments of 15 cells were observed.

47. PLEUROTÆNIUM CALDENSE, *Nordst., in Öfvers. K. Vet.-Akad. Förh.* (1877) no. 3, p. 17, t. 2. fig. 2.

Forma AFRICANA. (Pl. **6.** fig. 1.)

Forma cellulis longioribus, leviter attenuatis apices versus, tuberculis apicalibus 18 (9–10 visis).

Long. 670 μ; lat. ad bas. semicell. 34 μ; lat. apic. 25 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

The African form differs principally from the Brazilian one in the distinct attenuation of the apical part of the semicells.

48. PLEUROTÆNIUM EHRENBERGII, (*Bréb.*) *De Bary, Conj.* (1858) p. 75; *W. & G. S. West, Brit. Desm.* i. (1904) p. 205, t. 29. figs. 9–11.—Docidium Ehrenbergii, *Bréb.*

Nyasa.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

Victoria Nyanza.—In swampy pools near Bukoba (20 Apr. 1905; nos. 251 and 618).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).

49. PLEUROTÆNIUM TRABECULA, (*Ehrenb.*) *Näg. Gatt. einz. Alg.* (1849) p. 104, t. 6. fig. A; *W. & G. S. West, l. c.* p. 209, t. 30. figs. 11–13.

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 251).

50. PLEUROTÆNIUM MAXIMUM, (*Reinsch*) *Lund. in Nov. Act. Reg. Soc. Sci. Upsal.* ser. 3, viii. (1871) p. 89; *W. & G. S. West, l. c.* p. 213, t. 31. figs. 1, 2.—Docidium maximum, *Reinsch.*

Long. 720 μ; lat. ad bas. semicell. 40 μ, ad apic. 28 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Genus EUASTRUM, *Ehrenb.*

51. Euastrum sinuosum, *Lenorm. ex Ralfs, Brit. Desm.* (1848) p. 85; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 20, t. 36. fig. 1.

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 618).

52. Euastrum ansatum, *Ralfs, l. c.* t. 14. fig. 2.

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905; no. 251).

53. Euastrum rostratum, *Ralfs, in Ann. Nat. Hist.* xiv. (1844) p. 192; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 35, t. 37. figs. 11–13.

Long. 46 μ; lat. 27 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

54. Euastrum personatum, *W. & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* v. (1895) p. 52, t. 6. fig. 19.

Forma incisuris apicalibus leviter apertioribus, angulis basalibus semicellularum delicatissime bidenticulatis.

Long. 48 μ; lat. 32 μ; lat. isthm. 9 μ; crass. 17 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

55. Euastrum elegans, (*Bréb.*) *Kütz. Phyc. Germ.* (1845) p. 135; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 48, t. 38. figs. 16–21.

Forma angulis basalibus semicellularum sursum divergentibus.

Long. 31 μ; lat. 20 μ; lat. isthm. 6·5 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

56. Euastrum binale, (*Turp.*) *Ehrenb. in Berlin Monatsber.* (1840) p. 208; *W. & G. S. West, l. c.* p. 51, t. 38. figs. 28, 29.

Forma hians, *West, in Journ. Linn. Soc., Bot.* xxix. (1892) p. 140, t. 20. fig. 14.

Nyasa.—Among Algæ growing on stones, Domira Bay (19 June, 1904; no. 17).

Var. subelobatum, *West, l. c.* p. 140, t. 20. fig. 15.

Long. 21 μ; lat. 16·5 μ; lat. isthm. 5 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

57. Euastrum denticulatum, (*Kirchn.*) *F. Gay, in Bull. Soc. Bot. Fr.* xxxi. (1884) p. 335.—E. binale, *var.* denticulatum, *Kirchn. Alg. Schles.* (1878) p. 159.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

58. Euastrum hypochondroides, *W. & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* v. (1895) p. 49, t. 6. fig. 8.

Victoria Nyanza.—Among *Utricularia* in sheltered bay near Entebbe (1 May, 1905; no. 620).

59. EUASTRUM SPINULOSUM, *Delp. in Mem. Accad. Sci. Torino*, ser. 2, xxx. (1878) p. 97, t. 6. figs. 17, 18.

Subsp. AFRICANUM, *Nordst. in Act. Univ. Lund.* xvi. (1880) p. 9, t. 1. fig. 16.
Small form: long. 56 μ; lat. 48 μ; lat. isthm. 12 μ.
Tanganyika.—Among Algæ in swamp, Mrumbi (27 Dec. 1904; no. 196).

—— forma DUPLO-MINOR, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 51, t. 6. fig. 13.
Long. 44 μ; lat. 39 μ.
Nyasa.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

60. EUASTRUM PSEUDOPECTINATUM, *Schmidle, in Engl. Bot. Jahrb.* xxvi. (1898) p. 46, t. 2. fig. 39.
Forma mucronibus lobi polaris reductis. (Pl. **7.** figs. 4–5.)
Long. 44–46 μ; lat. 34–35·5 μ; lat. lob. polar. 20–21·5 μ; lat. isthm. 8 μ.
Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

61. EUASTRUM TRUNCATIFORME, sp. n. (Pl. **7.** fig. 3.)
E. submediocre, circiter 1½-plo longius quam latius, profundissime constrictum, sinu angusto-lineari extremo subampliato; semicellulæ trilobæ, incisuris lateralibus subprofundis et angustis; lobis lateralibus sinuato-bilobulatis, lobulis subquadratis rotundo-emarginatis; lobo polari transverse rectangulari-fusiformi, lateribus sursum convergentibus et retusis, apice convexo; tumore magno glabro in lobo laterali unoquoque, tumore magno in centro lobi polaris, tumore parvo intra lobulum lateralem unumquemque; a vertice visæ oblongo-ellipticæ, polis rotundatis, tumoribus magnis binis subdistantibus utrobique et tumore parvo polum unumquemque versus utrobique, lobo polari subrhomboideo; a latere visæ subovatæ, tumore magno prope basin et tumore minore apicem rotundatum versus utrobique.
Long. 47 μ; lat. 33 μ; lat. lob. polar. 21 μ; lat. isthm. 8 μ; crass. 19 μ.
Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).
This species bears considerable resemblance to *E. sympageum*, W. & G. S. West (in Trans. Linn. Soc. ser. 2, Bot. v. (1895) p. 50, t. 6. fig. 11), a species known only from Madagascar, but is distinguished by the relatively smaller polar lobe, by the strongly retuse lateral lobes with broader angles (lobules), and by the different disposition of the surface tumours, the latter feature causing considerable differences in the vertical and lateral views.

It should also be compared with *E. truncatum*, Joshua (*vide* W. & G. S. West, *l. c.* vi. (1902) p. 152, t. 20. figs. 9, 10), from which it differs in the deeply retuse lateral lobes, the convex apex of the polar lobe, and the form of the polar lobe in vertical view. The three large tumours of *E. truncatiforme* also occur in the same relative positions on *E. truncatum*, but the latter possesses two others within the angles of the polar lobe, and

lacks the small tumours which occur within the lateral lobules of *Euastrum truncatiforme*. The large scrobiculation in the centre of the semicells of *E. truncatum* is likewise absent from *E. truncatiforme*.

Compare also with *E. pseudopectinatum*, Schmidle, var. *evolutum*, Schmidle (in Engl. Bot. Jahrb. xxxii. (1903) p. 72, t. 2. fig. 6).

Genus MICRASTERIAS, *Ag.*

62. MICRASTERIAS INCISA, *Bréb., ex Ralfs, Brit. Desm.* (1848) p. 211; *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 89 (*α. typica*).—Euastrum incisum, *Bréb. in Menegh. Synops. Desm.* (1840) p. 216. Holocystis incisa, *G. C. Wall. in Ann. Mag. Nat. Hist.* ser. 3, v. (1860) p. 276, t. 13. figs. 4, 5.

Forma lobis lateralibus oblique truncatis; spinis totis minoribus.

Long. 56 μ; lat. cum spin. 60 μ; lat. isthm. 11 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

63. MICRASTERIAS CUNNINGTONII, sp. n. (Pl. 7. figs. 1–2.)

M. mediocris, circiter 1½-plo longior quam latior, elliptica, profundissime constricta, sinu angusto sed leviter aperto; semicellulæ quinquelobæ, incisuris inter lobos non profundis et apertis; lobo polari late et breviter cuneato (late campanulato e basi subangusto), apice convexo sed late emarginato ad medium, cum dentibus irregularibus circ. 10 ad marginem superiorem et angulis lateralibus unidentatis; lobis lateralibus subæqualibus (superioribus majoribus), cum incisura primaria mediana et incisuris parvis secundis duobus, lobulis emarginato-bispinatis (raro trispinatis) quattuor; membrana irregulariter et subsparse denticulato-spinata. Semicellulæ a latere visæ ovato-lanceolatæ, ad basin subrotundatæ, lateribus subretusis, apice rotundato et tridentato, marginibus lateralibus dense denticulato-spinatis.

Long. 192 μ; lat. 138 μ; lat. max. lob. polar. 74–78 μ; lat. isthm. 28 μ; crass. sine spin. 54–56 μ.

Victoria Nyanza.—In swampy pools near the shore, Bukoba (20 Apr. 1905; no. 251).

This species can best be compared with *M. apiculata*, (Ehrenb.) Menegh., from which it is at once distinguished by the shallow incisions and the much wider and shorter polar lobe. The spines are also shorter, and they are much more irregular in size and disposition than those of *M. apiculata*, especially towards the centre of the semicells. It is, however, the polar lobe which is the distinctive feature of *M. Cunningtonii*. It is very widely campanulate from a rather narrow base, and the disposition of the spines on its convex-emarginate apex is also peculiar.

64. MICRASTERIAS AMERICANA, (*Ehrenb.*) *Ralfs, Brit. Desm.* (1848) p. 19 *W. & G. S. West, Brit. Desm.* ii. (1905) p. 117, t. 53. figs. 4, 5, t. 54. figs. 1–3

Victoria Nyanza.—Among *Utricularia* in swampy pool, Bukoba (20 Apr 1905; no. 618).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 124).

Genus COSMARIUM, *Corda.*

65. COSMARIUM OBSOLETUM, (*Hantzsch*) *Reinsch, Sp. Gen. Alg.* (1867) p. 142, t. 22. D.I. figs. 1–4; *W. & G. S. West, l. c.* p. 133, t. 56. figs. 1–3.

Nyasa.—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

Victoria Nyanza.—In swampy pools near the shore, Bukoba (20 Apr. 1905; no. 251).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72. Also 26 Aug. 1904; no. 80).

66. COSMARIUM LUNDELLII, *Delp. in Mem. Accad. Sci. Torino,* ser. 2, xxx. (1878) p. 13, t. 7. figs. 62–64.—C. subcirculare, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 52, t. 8. fig. 3, and t. 9. figs. 27, 37.

Var. MADAGASCARIENSE, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 55, t. 8. fig. 2.

Long. 74 μ; lat. 67 μ; lat. isthm. 29 μ.

Nyasa.—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

67. COSMARIUM SUBAURICULATUM, *W. & G. S. West, l. c.* p. 55, t. 6. fig. 31.

Forma sinu non aperto.

Long. 48–56 μ; lat. sine spin. 46–54 μ; lat. cum spin. 49–58 μ; lat. isthm. 27–30 μ.

Nyasa.—In pools on the shore, Nkata Bay (23 June, 1904; no. 22).

Victoria Nyanza.—Among *Utricularia,* near Entebbe (1 May, 1905; no. 620).

This species has been recorded by Schmidle from the vicinity of Lake Nyasa (*vide* Engl. Bot. Jahrb. xxxii. (1903) p. 68, t. 1. fig. 24). It is now known to occur in Madagascar, Central Africa, Siam, and Central China.

The Desmid described by Gutwinski from Java as *C. suberosum* (Gutw. in Bull. de l'Acad. Sci. Cracov., Nov. 1902, p. 592, t. 38. fig. 36) is identical with *C. subauriculatum* var. *truncatum,* W. & G. S. West, in Bot. Tidsskr. xxiv. (1901) p. 172, t. 2. fig. 20, described from the island of Koh Chang in the Gulf of Siam.

68. COSMARIUM FONTIGENUM, *Nordst. in Wittr. & Nordst. Alg. Exsic.* 1878, no. 171; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 147, t. 59. figs. 16, 17.

Long. 24·5 μ; lat. 24·5 μ; lat. isthm. 7 μ.

Nyasa.—Among *Utricularia,* Domira Bay (19 June, 1904; no. 579).

69. Cosmarium Phaseolus, *Bréb. in Menegh. Synops. Desm.* (1840) p. 220; *Ralfs, Brit. Desm.* (1848) p. 106, t. 32. fig. 5.

A form approaching var. *elevatum*, Nordst.

Nyasa.—Among Algæ on the shore, Domira Bay (19 June, 1904; no. 17).

70. Cosmarium bioculatum, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 95, t. 15. fig. 5; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 165, t. 61. figs. 3–7.

Forms with a punctate cell-wall, some individuals approaching var. *hians*, W. & G. S. West: long. 19–21 μ; lat. 16–18 μ; lat. isthm. 4·5–6 μ.

Victoria Nyanza.—Among *Utricularia*, near Bukoba (20 Apr. 1905; no. 618.

71. ? Cosmarium minutissimum, *Arch. in Quart. Journ. Micr. Sci.* xvii. (1877) pp. 194 and 301.

Long. 11 μ; lat. 9 μ; lat. isthm. 3 μ; crass. 5·5 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

It is with much doubt that I refer this minute *Cosmarium* to *C. minutissimum*, Arch., a species concerning which very little is definitely known. Another African form, from Huilla, Angola, W. Africa, has also been with uncertainty regarded as *C. minutissimum* (*vide* W. & G. S. West, in Journ. Bot. xxxv. (1897) p. 38). The sinus of the Nyanza specimens was not "a narrow incision" as described by Archer, and the outline of the cell was exactly similar to that exhibited by some forms of *C. contractum*, var. *ellipsoideum*.

72. Cosmarium contractum, *Kirchn. Alg. Schles.* (1878) p. 47; *Wolle, Desm. U.S.* (1884) p. 63, t. 50. fig. 24; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 170, t. 61. figs. 23–25, 34.

Var. ellipsoideum, (*Elfv.*) *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxii. part i. (1902) p. 40.—C. ellipsoideum, *Elfv.*

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249). In sheltered bay near Entebbe (1 May, 1905; no. 620).

73. Cosmarium depressum, (*Näg.*) *Lund. in Nov. Act. Reg. Soc. Sci. Upsal.* ser. 3, viii. (1871) p. 38; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 176, t. 62. figs. 2–5. –C. Scenedesmus, *Delp.*

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249).

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

74. Cosmarium retusiforme, (*Wille*) *Gutw. in Bot. Centralbl.* xliii. (1890) p. 69.—C. Hammeri, *Reinsch, var.* retusiforme, *Wille.*

Forma abscissum (*Schmidle*), *Borge, in Arkiv för Bot. K. Sv. Vet.-Akad.* i. (1903) p. 96, t. 3. fig. 19.—C. Hammeri, *Reinsch, f.* abscissa, *Schmidle, in Hedwigia,* xxxiv. (1895) p. 302, t. 4. fig. 8.

Long. 22–31 μ; lat. 17–23 μ; lat. apic. 9·5–13·5 μ; lat. isthm. 5–6·5 μ.

Victoria Nyanza.—Near Bukoba (20 Apr. 1905; no. 618). In sheltered bay near Entebbe (1 May, 1905; no. 620).

This form was not uncommon from the above localities, and to a certain extent it combines the characters of *C. retusum*, (Perty) Rabenh., and *C. retusiforme*, (Wille) Gutw. It has the deep linear constriction of the former, but the proportions of the latter. The subrectangular basal angles are distinctive. It appears to be a tropical form with a wide geographical distribution, and was first described from Sumatra.

75. COSMARIUM HAMMERI, *Reinsch, Sp. Gen. Alg.* (1867) p. 115, t. 22 B.I. figs. 1–10 ; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 181, t. 62. figs. 20, 21.

Long. 30 μ ; lat. 22 μ ; lat. isthm. 6 μ ; crass. 11 μ.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

76. COSMARIUM GRANATUM, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 96, t. 32. fig. 6 ; *W. & G. S. West, l. c.* p. 186, t. 63. figs. 1–3.

Nyasa.—In pools, Nkata Bay (23 June, 1904 ; no. 22). In swamp, Karonga (2 July, 1904 ; no. 34).

77. COSMARIUM GALERITUM, *Nordst. in Vidensk. Medd. Naturh. Foren. Kjöb.* (1870) p. 209, t. 3. fig. 26.

Var. RETUSUM, var. n. (Pl. **7.** fig. 6.)

Semicellulæ lateribus paullo retusis apicem versus et apice leviter retuso.

Long. 38 μ ; lat. 34 μ ; lat. isthm. 10 μ.

Nyasa.—In the swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Victoria Nyanza.—In sheltered bay near Entebbe (1 May, 1905 ; no. 620).

The Desmid described and figured by Schmidle from Nyasa (*cf.* Engl. Bot. Jahrb. xxxii. (1903) p. 69, t. 1. fig. 26) as "*C. homalodermum* var. *minor*" is most probably identical with this variety.

78. COSMARIUM NITIDULUM, *De Not. Desm. Ital.* (1867) p. 42, t. 3. fig. 26 ; *W. & G. S. West, Brit. Desm.* ii. (1905) p. 197, t. 64. figs. 1–3.

Small form : long. 25 μ ; lat. 21 μ ; lat. isthm. 5 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 124).

79. COSMARIUM PSEUDOPYRAMIDATUM, *Lund. in Act. R. Soc. Sci. Upsal.* ser. 3, viii. (1871) p. 41, t. 2. fig. 18.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72. Also 26 Aug. 1904 ; no. 80).

80. COSMARIUM MONILIFORME, (*Turp.*) *Ralfs, Brit. Desm.* (1848) p. 107, t. 17. fig. 6.

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905 ; no. 249).

81. Cosmarium globosum, *Buln. in Hedwigia,* ii. (1861) p. 52, t. 9. fig. 8.

Var. Wollei, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1896) p. 252, t. 15. fig. 17.—C. globosum, *Wolle, Desm. U.S.* (1884) p. 60, t. 49. figs. 15–17.

Forma major: long. 44–49 μ; lat. 37–39 μ; lat. isthm. 35–37 μ. (Pl. 7. fig. 10.)

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905; nos. 251 and 618).

Tanganyika.—In swamp close to shore, Kituta (23 Aug. 1904; nos. 72 and 73. Also 26 Aug. 1904; no. 80).

This *Cosmarium* occurred in some abundance, and is characterized by the slightness of its constriction. In outline the African specimens agreed exactly with the figures given by Wolle, but they were of decidedly larger dimensions.

There is one pyrenoid in each semicell, from which radiate a number of vertically-disposed divisions of the chloroplast.

The specimens very closely resemble a Desmid described by Schmidle from Zanzibar as *Dysphinctium subellipticum* (*vide* Engl. Bot. Jahrb. xxvi. (1898) p. 21, t. 1. fig. 15), but there was no large series of punctulations on each side of the isthmus.

82. Cosmarium subconstrictum, *Schmidle, in Engl. Bot. Jahrb.* xxx. (1901) p. 66, t. 2. fig. 4.

Long. 27–30 μ; lat. 26–28 μ; lat. isthm. 17–20 μ; crass. 17–19 μ.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905; nos. 251 and 618).

This species was fairly abundant, and seems well characterized by its shallow constriction and by the two pyrenoids in each semicell.

83. Cosmarium Regnesi, *Reinsch, in Abh. Naturh. Ges. Nürnb.* iii. (1866) p. 112, t. 7. fig. 8; *G. S. West, in Journ. Linn. Soc., Bot.* xxvii. (1899) p. 387, t. 10. figs. 10–21.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

84. Cosmarium planum, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 59, t. 8. fig. 9.

Long. 29 μ; lat. 18 μ; lat. isthm. 6 μ.

Nyasa.—In shore pools, Nkata Bay (23 June, 1904; no. 22).

85. Cosmarium minimum, *W. & G. S. West, l. c.* p. 58, t. 8. fig. 10.

Several slightly different forms.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

86. Cosmarium sexangulare, *Lund. in Act. R. Soc. Sci. Upsal.* ser. 3, viii. (1871) p. 35, t. 2. fig. 23.

Forma minimum, *Nordst. in Bot. Notiser* (1887), p. 162; *in K. Sv. Vet.-Akad. Handl.* xxii. (1888) no. 8, p. 60, t. 7. fig. 26.

Long. 13·5 μ ; lat. 11·5 μ ; lat. isthm. 3 μ ; lat. apic. 6 μ.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34). Among *Utricularia*, Domira Bay (19 June, 1904 ; no. 579).

Tanganyika.—In swamp, Kituta (26 Aug. 1904 ; no. 80).

87. Cosmarium abruptum, *Lund. tom. cit.* p. 43, t. 2. fig. 22.

Var. granulatum, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 65, t. 7. fig. 32.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

88. Cosmarium Meneghinii, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 96, t. 15. fig. 6.

Forma octangulare, *Wille, in Öfvers. K. Vet.-Akad. Förh.* (1879) no. 5, p. 43, t. 12. fig. 35.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 33).

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251),

89. Cosmarium angulosum, *Bréb. in Mém. Soc. Sci. Nat. Cherb.* iv. (1856) p. 127, t. 1. fig. 17.

Nyasa.—Among Algæ on shore, Domira Bay (19 June, 1904 ; no. 17). In swamp, Kota Kota (20 June, 1904 ; no. 18).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

Var. concinnum, *(Rabenh.) W. & G. S. West, in Bot. Tidsskr.* xxiv. (1901) p. 91.—Cosmarium concinnum, *Reinsch.*

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905 ; no. 618). Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

90. Cosmarium læve, *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 161 ; *G. S. West, in Journ. Linn. Soc., Bot.* xxvii. (1899) p. 386, t. 10. figs. 1–6.

Nyasa.—Among Algæ on shore, Domira Bay (19 June, 1904 ; no. 17).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Var. minimum, *W. & G. S. West, in Journ. Bot.* xxxv. (1897) p. 119, t. 368. fig. 6.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

91. Cosmarium Cunningtonii, sp. n. (Pl. **7**. fig. 7.)

C. parvum, circiter $1\frac{1}{3}$-plo longius quam latius, profundissime constrictum, sinu angustissimo-lineari extremo paullo ampliato ; semicellulæ pyramidatæ (vel pyramidato-subtrapeziformes), angulis basalibus truncato-rectangularibus

(interdum levissime retusis), lateribus subrectis vel levissime convexis, angulis superioribus subrotundatis, apice subtruncato-convexo, infra et juxta apicem granulis magnis binis ornatæ, granulo singulo ad angulis basalibus juxta sinum, et scrobiculis conspicuis quincuncialiter ordinatis in centro semicellulæ ; a vertice visæ ellipticæ, polis levissime truncatis, intra marginem unumquemque granulis magnis binis instructæ ; a latere visæ oblongo-ellipticæ (vel elliptico-circularis), ad apicem utrinque granulo magno ornatæ ; pyrenoidibus binis.

Long. 42–44 μ ; lat. 31·5–32·5 μ ; lat. isthm. 9 μ ; crass. 19 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

This species stands nearest to *C. bigemma*, Racib. (in Pamietnik matem.-przy. Akad. Umiej. Krakow. xvii. (1889) p. 85, t. 5. fig. 10), from which it is distinguished by the truncate basal angles of the semicells, the smooth sides and slightly convex apex, as well as by the two pyrenoids in each chloroplast.

It should also be compared with *C. supergranatum*, W. B. Turn., forma *pulchrum*, W. B. Turn. (in K. Sv. Vet.-Akad. Handl. xxv. (1893) no. 5, p. 57, t. 9. fig. 24), and *C. ceylanicum*, W. & G. S. West (in Trans. Linn. Soc. ser. 2, Bot. vi. (1902) p. 174, t. 21. figs. 14, 15).

92. COSMARIUM SCABRATULUM, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 64, t. 6. fig. 27.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

Tanganyika.—In swamp, Kituta (26 Aug. 1904 ; no. 80).

93. COSMARIUM PRÆMORSUM, *Bréb. in Mém. Soc. Sci. Nat. Cherb.* iv. (1856) p. 128, t. 1. fig. 8; *Nordst. in Act. Univ. Lund,* ix. (1873) p. 12, t. 1. fig. 1.

Victoria Nyanza.—In sheltered bay, near Entebbe (1 May, 1905; no. 620).

94. COSMARIUM DECACHONDRUM, *Roy & Biss. in Journ. Bot.* xxiv. (1886) p. 196, t. 268. fig. 15.

Var. ORNATUM, var. n. (Pl. **7**. fig. 8.)

Var. semicellulis depressis, granulis infra sed juxta apicem majoribus et conspicuis, cum granulum supra isthmum et granulis duobus apicem versus.

Long. 26 μ ; lat. 26–29 μ ; lat. isthm. 9 μ ; crass. 17 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

This variety differs from the type in the somewhat flattened apices, the more conspicuous apical granules, the single granule above the isthmus, and the two granules below the apex of the semicells. Schmidle has described a var. *striatum* of this species from Zanzibar and Mozambique.

It is closely allied to varieties of *C. taxichondrum*, Lund., especially to var. *subundulatum*, Boldt, and its form *subdenticulatum*, W. & G. S. West.

95. Cosmarium Blyttii, *Wille, in Vid.-Selsk. Forhandl. Christiania* (1880), no. 11, p. 25, t. 1. fig. 7.

Nyasa.—On the shore, Domira Bay (19 June, 1904; no. 17).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123).

96. Cosmarium subcostatum, *Nordst. in Öfvers. K. Vet.-Akad. Förh.* (1876) no. 6, p. 37, t. 12. fig. 13.

Long. 33 μ; lat. 29 μ; lat. isthm. 9 μ.

Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208).

Forma minus, *W. & G. S. West, in Journ. Bot.* xxxiv. (1896) p. 379, t. 361. fig. 15.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

97. Cosmarium subprotumidum, *Nordst. in Öfvers. K. Vet.-Akad. Förh.* (1876) p. 38, t. 12. fig. 14.

Long. 24–25 μ; lat. 22–23 μ; lat. isthm. 6–7 μ.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

Schmidle has described a species from Nyasa as *C. occultum* which stands very near to *C. subprotumidum*.

98. Cosmarium glyptodermum, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 69, t. 7. fig. 23.

Long. 70–80 μ ; lat. 45–55 μ ; lat. isthm. 34 μ.

Tanganyika.—Abundant in swamp, Kituta (23 Aug. 1904 ; no. 72. Also 26 Aug. 1904 ; no. 80).

99. Cosmarium binum, *Nordst. in Wittr. & Nordst. Alg. Exsic.* (1880) no. 383, fasc. 21 (1889), p. 39 ; *De Toni, Syll. Alg.* i. p. 993.

Nyasa.—In shore pools, Nkata Bay (23 June, 1904 ; no. 22).

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 123).

100. Cosmarium subspeciosum, *Nordst. in Öfvers. K. Vet.-Akad. Förh.* (1875) no. 6, p. 22, t. 6. fig. 13.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

101. Cosmarium multiordinatum, *W. & G. S. West, in Journ. Bot.* xxxv. (1897) p. 121, t. 367. fig. 8.

Long. 66 μ ; lat. 48 μ ; lat. isthm. 15 μ.

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

The original examples of this species were described from Pungo Andongo

in Angola, W. Africa. The Nyanza specimens were relatively a little longer, but otherwise precisely similar.

One of the chief features of this species is the presence between the granules of small rounded scrobiculations similar to those of *C. margaritatum* (Lund.), Roy & Biss.; and I should like once more to emphasize the fact that it is the only species of its section in which the hexagons of scrobiculations are disposed so that two opposite sides are horizontal.

Schmidle (in Engl. Bot. Jahrb. xxvi. (1898) p. 27, t. 1. fig. 20) has described and figured a *Cosmarium* from Zanzibar, which he names "*C. multi-ordinatum*, forma," but which is most probably a form of *C. decoratum*, W. & G. S. West.

102. Cosmarium quadrum, *Lund. in Act. R. Soc. Sci. Upsal.* ser. 3, viii. (1871) p. 25, t. 2. fig. 11.

Forma granulis paullo minoribus.

Long. 66 μ; lat. 65 μ; lat. isthm. 22 μ.

Nyasa.—Among Algæ on rocks, Nkata Bay (23 June, 1904; no. 23).

This form was very slightly smaller than the original Swedish plants, and the granules were rather more numerous and of somewhat smaller size.

103. Cosmarium margaritatum, (*Lund.*) *Roy & Biss. in Journ. Bot.* xxiv. (1886) p. 194.—C. latum, *Bréb.*, *var.* margaritatum, *Lund.*

Long. 66 μ; lat. 60 μ; lat. isthm. 19 μ.

Nyasa.—Among Algæ on stones, Domira Bay (19 June, 1904; no. 17).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 124).

104. Cosmarium lacunatum, sp. n.

C. mediocre, circiter tam longum quam latum, profundissime constrictum, sinu angusto *introrsum valdissime ampliato* (*lacunato*), isthmo breviter cylindrico; semicellulæ trapeziformes, angulis superioribus et inferioribus rotundatis, apice lato recto vel levissime concavo, lateribus leviter convexis et sursum divergentibus; membrana granulata, granulis in seriebus obliquis (circ. 14) ordinatis, in ambitu toto semicellularum cum granulis circiter 35, punctulis minutis 5–6 circa granulum unumquemque; a vertice visæ anguste ellipticæ vel oblongo-ellipticæ, polis rotundatis.

Long. 77 μ; lat. bas. semicell. 60–62 μ; lat. apic. semicell. 80–86 μ; lat. isthm. 22 μ; crass. 37 μ.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

This remarkable *Cosmarium* is at once distinguished by the form of the semicells and the extraordinarily dilated sinus. The granulation is very similar to that of *C. margaritatum*, and, as in that species, small punctulations are present between the granules. Excluding the sinus, the outline of the semicells very much resembles that of *C. biretum*, Bréb.

One other curious feature of *C. lacunatum* is the narrowness of the vertical view, which is $2\frac{1}{3}$ times longer than broad.

Compare also with *C. sublatum*, Nordst.

105. Cosmarium Pseudobroomei, *Wolle, Desm. U.S.* (1884) p. 86, t. 51. figs. 36, 37 (fig. not good); *W. B. Turner, in K. Sv. Vet.-Akad. Handl.* xxv. (1893) n. 5, p. 66, t. 9. fig. 41; *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* vi. (1902) p. 170, t. 21. fig. 4.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18). In swamp, Karonga (2 July, 1904; no. 34).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123).

Var. compressum, var. n. (Pl. 7. fig. 11.)

Var. cellulis paullo latioribus quam longioribus, angulis superioribus magis rotundatis.

Long. 30 μ; lat. 35 μ; lat. isthm. 8 μ; crass. 18 μ.

Tanganyika.—Abundant in swamp, Kituta (23 Aug. 1904; no. 72).

Since Wolle's somewhat crude account of *C. Pseudobroomei* in 1884, the species has been found in many parts of the world and is now very well known.

A number of varieties have also been discovered, some of which appear to be well-marked and of constant character. The African variety most nearly approaches var. *convexum*, W. & G. S. West (in Trans. Bot. Soc. Edinb., Nov. 1904, p. 21, t. 1. fig. 22), in the roundness of the upper angles of its semicells, but the general proportions and the basal angles are quite different.

106. Cosmarium creperum, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 63, t. 7. fig. 11.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

This plant differs from typical *C. Pseudobroomei* in its open sinus and in its fewer and relatively smaller granules. In view, however, of the recently discovered varieties of *C. Pseudobroomei*, it would perhaps be better regarded as a variety of that species.

107. Cosmarium pseudamœnum, *Wille, in Bih. K. Sv. Vet.-Akad. Handl.* viii. (1884) no. 18, p. 18, t. 1. fig. 37.—C. inornatum, *Joshua, in Journ. Linn. Soc., Bot.* xxi. (1886) p. 648, t. 24. figs. 26, 27.

a. Forma paullo major: long. 59 μ; lat. 28 μ; lat. isthm. 23 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

b. Forma major et paullo longioribus: long. 71 μ; lat. 29 μ; lat. isthm. 24 μ.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

Many of the specimens of the latter form were considerably larger than any I have previously examined, and in some the granules were more evidently arranged in transverse than in longitudinal series.

Genus XANTHIDIUM, *Ehrenb.*

108. Xanthidium cristatum, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 115, t. 19. fig. 3.

Forma semicellulis subsemicirculari-trapeziformibus, sinu aperto, spinis basalibus paullo reductis (interdum duplicatis ut in *X. fasciculato*).

Long. sine spin. 60 μ, cum spin. 74 μ; lat. sine spin. 46 μ, cum spin. 58 μ; lat. isthm. 15 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Genus ARTHRODESMUS, *Ehrenb.*

109. Arthrodesmus Incus, (*Bréb.*) *Hass. Brit. Freshw. Algæ*, p. 357 (1845); *Ralfs, Brit. Desm.* (1848) p. 118, t. 20. fig. 4 *a–d*.

Var. Ralfsii, *W. & G. S. West, Alga-fl. Yorks.* (1901) p. 109.—A. Ralfsii, *West, in Journ. Linn. Soc., Bot.* xxix. (1892) p. 168. A. Incus, *Ralfs, l. c.* t. 20. fig. 4 *e–h*.

a. Forma semicellulis triangularibus, apice recto, spinis validis variabiliter curvatis subhorizontaliter dispositis.

Long. 20 μ; lat. sine spin. 16 μ, cum spin. 52 μ. (Pl. 6. fig. 13.)

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).

b. Forma spinis multe brevioribus.

Long 14·5 μ; lat. sine spin. 13 μ; long. spin. 3·5 μ.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618).

This form is almost identical with one observed in the Scottish plankton (*vide* W. & G. S. West, in Trans. Roy. Soc. Edinb. xli. pt. iii. (1905) p. 501 t. 7. fig. 10).

Genus STAURASTRUM, *Meyen.*

110. Staurastrum Dickiei, *Ralfs, Brit. Desm.* (1848) p. 123, t. 14. fig. 23.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

111. Staurastrum cuspidatum, *Bréb. in Menegh. Synops. Desm.* (1840) p. 226; *Ralfs, l. c.* p. 122, t. 21. fig. 1.

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).

112. Staurastrum brevispinum, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 124, t. 34. fig. 7.

Var. inerme, *Wille, in Öfvers. K. Vet.-Akad. Förh.* 1879, no. 5, p. 52, t. 13. fig. 62.

Forma tetragona: long. 40–43 μ; lat. 32–38 μ; lat. isthm. 14–17 μ.

Victoria Nyanza.—In plankton with preceding species (no. 252).

113. Staurastrum orbiculare, (*Ehrenb.*) *Menegh. in Linnæa*, xiv. (1840) p. 225; *Nordst. in Wittr., Nordst. & Lagerh. Alg. Exsic.* fasc. 35 (1903) pp. 9–10 (c. fig.).

Var. depressum, *Roy & Biss. in Journ. Bot.* xxiv. (1886) p. 237, t. 268. fig. 14.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

114. Staurastrum turgescens, *De Not. Desm. Ital.* (1867) p. 51, t. 4. fig. 43; *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxii. sect. B (1902), p. 50, t. 2. fig. 32.

Forma minor: long. 28 μ; lat. 25 μ; lat. isthm. 10 μ.

Nyasa.—In shore pools, Nkata Bay (23 June, 1904; no. 22).

115. Staurastrum punctulatum, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 113, t. 22. fig. 1.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905; no. 251).

116. Staurastrum alternans, *Bréb. in Ralfs, l. c.* p. 132, t. 21. fig. 7.

Tanganyika.—In plankton, Kalambo (5 Nov. 1904; no. 154).

117. Staurastrum sinense, *Lütkem. in Ann. des k.-k. Naturhist. Hofmus. Wien*, xv. (1900) p. 124, t. 6. figs. 39, 40.

Long. 18–18·5 μ; lat. 18–23 μ; lat. isthm. 7 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

118. Staurastrum pilosum, (*Näg.*) *Arch. in Pritch. Infus.* (1861) p. 739.—Phycastrum pilosum, *Näg. Gatt. einz. Alg.* 1849, p. 126, t. 8 A. fig. 4.

Var. minimum, var. n. (Pl. **6.** fig. 5.)

Var. perparva, spinis ut in forma typica sed minoribus.

Long. sine spin. 22 μ, cum spin. 25 μ; lat. sine spin. 20–22 μ, cum spin. 25 μ; lat. isthm. 6 μ.

Victoria Nyanza.—Swampy pool, Bukoba (20 Apr. 1905; no. 618).

119. Staurastrum echinatum, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 215, t. 35. fig. 24 (figure poor); *W. & G. S. West, in Bot. Tidsskr.* xxiv. (1901) p. 177, t. 3. fig. 31.

Small form: long. sine spin. 26 μ, cum spin. 31 μ; lat. sine spin. 23 μ, cum spin. 32 μ; lat. isthm. 8 μ.

Victoria Nyanza.—With the preceding species (no. 618).

Except for being slightly smaller, the specimens agreed very well with those observed from Siam. The cells were of the same form, and the spines were of the same size and length.

120. Staurastrum setigerum, *Cleve, Bidr.* p. 490 (1863); *Roy & Biss. in Ann. Scott. Nat. Hist.* (1893) p. 243; *ib.* (1894) t. 3. fig. 9.

Var. Nyansæ, *Schmidle, in Engl. Bot. Jahrb.* xxvi. (1898) p. 53, t. 4. fig. 8.

Long. sine acul. 60 μ, cum acul. 77 μ; lat. sine acul. 48–52 μ, cum acul. 84–90 μ; lat. isthm. 11 μ.

Victoria Nyanza.—In the plankton, Bukoba (21 Apr. 1905; no. 252).

This Desmid was not uncommon in the plankton of Victoria Nyanza, but the specimens observed were decidedly larger than those collected by Stuhlmann in 1872 and subsequently described by Schmidle (1898). The var. *Nyansæ* appears to differ from the type in the deeper constriction and in the fewer number of the more delicate aculei. Even in European specimens, however, the number of these delicate aculei is very variable.

121. Staurastrum quadrangulare, *Bréb. in Ralfs, Brit. Desm.* (1848) p. 128, t. 34. fig. 11, t. 22. fig. 7.

Var. attenuatum, *Nordst. in Vidensk. Medd. Naturh. Foren. Kjöb.* (1870) p. 229, t. 4. fig. 44.

Forma angulis semicellularum compressis, cum spinis duobus supra et spinis singulis vel binis infra; a vertice visis pentagonis, lateribus retusis, angulis bi- vel trispinatis. (Pl. **6.** fig. 6.)

Long. 25 μ; lat. sine spin. 21–24 μ, cum spin. 24–27 μ; lat. isthm. 9 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108).

Lagerheim has recorded a pentagonal form of this variety from Abyssinia (*vide* Nuova Notarisia, 1893, p. 164). The form observed from Tanganyika might equally well be regarded as a small pentagonal form of *S. angulare*, W. B. Turn. (in K. Sv. Vet.-Akad. Handl. xxv. (1893) no. 5, p. 130, t. 14. fig. 17), a species which appears scarcely to be distinct from *S. quadrangulare.*

122. Staurastrum monticulosum, *Bréb. in Menegh. Synops. Desm.* (1840) p. 226; *Ralfs, Brit. Desm.* (1848) p. 130, t. 34. fig. 9.

Var. bidens, var. n. (Pl. **6.** fig. 9.)

Semicellulæ a fronte visæ subrectangulares, verrucis bidenticulatis (vel bispinatis) binis supra angulum unumquemque; a vertice visæ quadratæ, lateribus levissime retusis, angulis bidenticulatis.

Long. sine dentic. 27 μ, cum dentic. 32 μ; lat. sine dentic. 22–26 μ, cum dentic. 26–32 μ; lat. isthm. 10 μ.

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251).

This variety differs from *S. monticulosum* var. *bifarium*, Nordst., in the absence of the six inferior accessory spinate warts. It closely approaches a Desmid described by Raciborski as *S. Libeltii* (in Pamietnik matem.-przy. Akad. Umiej. Krakow. xvii. (1889) p. 100, t. 7. fig. 12).

123. Staurastrum denticulatum, (*Näg.*) *Arch. in Pritch. Infus.* (1861) p. 738 ; *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxiii. sect. B (1906), p. 103, t. 11. fig. 11.—Phycastrum denticulatum, *Näg.*

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905 ; no. 618).

124. Staurastrum Cunningtonii, sp. n. (Pl. **6.** fig. 7.)

S. parvum, circiter tam longum quam latum (cum processibus), modice constrictum; semicellulæ campanulatæ, parte inferiore glabra, angulis superioribus in processus breves denticulatos horizontaliter dispositos productis, apicibus processuum tridenticulatis, apice convexo et verrucoso ; a vertice visæ triangulares, lateribus rectis (vel levissime convexis), angulis in processus breves denticulatos productis, cum dente conico ad basin processuum utrobique et verrucis bidenticulatis intra marginem lateralem unumquemque, in centro punctatæ.

Long. 30 μ ; lat. cum proc. 24–30 μ ; lat. isthm. 8 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

This species should be compared with *S. margaritaceum*, (Ehrenb.) Menegh., from which it is distinguished by the more delicate processes, the verrucose apex of the semicell, and the form of the vertical view. The triangular vertical view possesses a conical tooth at each side of the base of each process and a pair of bidenticulate warts within each lateral margin.

125. Staurastrum subgemmulatum, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 76, t. 8. fig. 34.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

126. Staurastrum mutabile, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 129, t. 16. fig. 42.

Long. 35 μ ; lat. 36 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

127. Staurastrum polymorphum, *Bréb., in Ralfs, Brit. Desm.* (1848) p. 135, t. 22. fig. 9, t. 34. fig. 6.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618).

128. Staurastrum pseudotetracerum, (*Nordst.*) *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 79.—S. contortum, *Delp., var.* pseudotetracerum, *Nordst. in K. Sv. Vet.-Akad. Handl.* xxii. (1888) no. 8, p. 37, t. 4. fig. 9.

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905; no. 251.)

129. Staurastrum tetracerum, *Ralfs, in Ann. Nat. Hist.* iv. (1845) p. 150 ; *Brit. Desm.* (1848) p. 137, t. 23. fig. 7 (figures not good).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72). In swamp, Mbete (28 Sept. 1904 ; no. 108).

Forma processibus minus divergentibus.

Long. sine proc. 8 μ, cum proc. 16 μ; lat. sine proc. 6 μ, cum proc. 29 μ; lat. isthm. 2·5 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

130. STAURASTRUM GRACILLIMUM, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 75, t. 8. fig. 1.

Forma 3-radiata.

Victoria Nyanza.—Among *Utricularia*, in sheltered bay near Entebbe (1 May, 1905; no. 620).

131. STAURASTRUM GRACILE, *Ralfs, in Ann. Nat. Hist.* xv. (1845) p. 155; *Brit. Desm.* (1848) p. 136, t. 22. fig. 12.

Var. SUBORNATUM, *Schmidle, in Engl. Bot. Jahrb.* xxvi. (1898) p. 51, t. 4. fig. 1.

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249).

Var. PROTRACTUM, var. n. (Pl. **6.** fig. 11.)

Var. apice semicellulæ protracto leviter retuso et glabro.

Long. 29 μ; lat. sine proc. circ. 16 μ, cum proc. 58–62 μ; lat. isthm. 7 μ.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904; no. 9).

Var. NYANSÆ, var. n. (Pl. **6.** fig. 10.)

Var. corpore semicellularum angustiore, ad basin inflato-bulboso, processibus incurvatis delicate noduloso-denticulatis.

Long. 26 μ; lat. sine proc. circ. 12 μ, cum proc. 48 μ; lat. isthm. 4·5 μ.

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249).

This variety is very near to *S. gracile* var. *elegantulum*, W. & G. S. West (in Trans. Linn. Soc. ser. 2, Bot. vi. (1902) p. 191, t. 22. fig. 20), but differs in the narrow and bulbous base of the semicells, and in the more incurved and more coarsely denticulate processes.

132. STAURASTRUM LONGIRADIATUM, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1896) p. 267, t. 17. fig. 23.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; n. 620).

133. STAURASTRUM SUBMANFELDTII, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* vi. (1906) p. 188, t. 22. fig. 16.

Victoria Nyanza.—With the preceding species (no. 620).

Forma semicellulæ a vertice visæ lateribus undulatis et denticulatis (verrucis emarginatis perreductis ornatis).

Long. 38 μ; lat. cum proc. 52–60 μ; lat. bas. semicell. 13·5 μ; lat. isthm. 8·5 μ.

Nyasa.—In swamp, Karonga (2 Aug. 1904; no. 34).

134. Staurastrum anatinum, *Cooke & Wills, in Journ. Quek. Micr. Club* (1881), t. 15. figs. 12, 13; *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxii. sect. B (1902), p. 54, t. 1. figs. 24, 25.

Var. subglabrum, var. n. (Pl. **6.** fig. 8.)

Var. corpore semicellularum verrucis emarginatis pæne destituto; processibus ut in forma typica.

Long. sine proc. 42 μ; lat. sine proc. 24–27 μ; cum proc. 84–96 μ; lat. isthm. 11·5 μ.

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).

Only a few of the emarginate warts are present on the semicells of this variety, but the processes are quite characteristic of the species.

135. Staurastrum leptocladum, *Nordst. in Vidensk. Medd. Naturh. Foren. Kjöb.* 1869, p. 228, t. 4. fig. 57.

Forma africanum, nob. (Pl. **6.** fig. 12.)

Forma paullo major, processibus subrectis et horizontaliter dispositis (parallelis), ad basin semicellulæ cum denticulis singulis vel binis; apicibus semicellularum convexis et glabris; semicellulis a vertice visis corpore lato elliptico-rotundato.

Long. 42–43 μ; lat. sine proc. circ. 11–21 μ, cum proc. 146–152 μ; lat. isthm. 6–7 μ; crass. 14 μ.

Nyasa.—In the plankton, near Mtangula (22 June, 1904; no. 20). Plankton, off Vahambwera Point (24 June, 1904; no. 24). Plankton, Deep Bay (24 June, 1904; no. 25). Plankton, off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905; no. 252).

This large form with horizontally-directed processes was frequent in the plankton of Nyasa and Victoria Nyanza. Schmidle mentions a form which is possibly identical with it as occurring in Stuhlmann's collections from Victoria Nyanza.

A few smaller specimens of *S. leptocladum* were observed from Victoria Nyanza in which the processes were shorter, and the two spines at the extremity of each process disposed in a horizontal plane, the bifurcation only being apparent in the vertical view.

136. Staurastrum limneticum, *Schmidle, in Engl. Bot. Jahrb.* xxvi. (1898) p. 52, t. 4. fig. 5.

Long. sine proc. 46–51 μ; lat. sine proc. circ. 28–36 μ, cum proc. 100–130 μ; lat. isthm. 14 μ. (Pl. **3.** figs. 8–10, 20.)

Victoria Nyanza.—Abundant in the plankton, Bukoba (18 Apr. 1905; no. 249, and 21 Apr. 1905; no. 252).

This species was in great abundance in the plankton of Victoria Nyanza, the locality from which Schmidle originally described it. The semicells possessed either five or six processes, which exhibited considerable variation in the denticulation. The denticulation of the under surfaces of the processes was commonly much more pronounced than that of the upper surfaces, but in some few cases the denticulation was almost equal all round the processes. Each process was terminated by three or four short spines.

Var. ACULEATUM, *Lemm. in Abh. Nat. Ver. Brem.* xvi. (1899) p. 344, t. 1. figs. 10, 11.

Long. sine proc. 36–38 μ; lat. sine proc. circ. 23–25 μ, cum proc. 103–128 μ; lat. isthm. 9 μ.

Victoria Nyanza.—Abundant with the type (nos. 249 and 252).

This variety was quite as abundant as the more typical form, and the semicells similarly possessed either five or six processes. It appears to differ from *S. limneticum* in two principal features:—the body of the semicell is relatively much smaller, and the processes are aculeate.

Lemmermann's specimens were from the plankton of Lake Wakatipu, New Zealand, and the African examples differed from his in the fewer and more irregularly disposed aculei, which were strongly reminiscent of those on the processes of *S. aspinosum*, Wolle, and *S. acanthastrum*, W. & G. S. West. Some individuals were noticed which possessed a few sharp aculei on the apex of the semicells near the bases of the processes.

137. STAURASTRUM TOHOPEKALIGENSE, *Wolle, Freshw. Alg. U.S.* (1887) p. 45, t. 59. figs. 4, 5.—S. nonanum, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 119, t. 15. fig. 14.

a. Forma triangularis: long. sine proc. 51 μ, cum proc. 86–91 μ; lat. sine proc. 35–36 μ, cum proc. 90–96 μ; lat. isthm. 16·5 μ.

b. Forma quadrangularis: long. sine proc. 49 μ, cum proc. 84 μ; lat. sine proc. 33–34 μ, cum proc. 76–78 μ; lat. isthm. 16 μ.

Victoria Nyanza.—Plankton, Bukoba (18 Apr. 1905; no. 249, and 21 Apr. 1905; no. 252).

Triangular and quadrangular forms of this species were equally abundant in the plankton of Victoria Nyanza. They were typical as regards proportions and length of processes, and the latter possessed two or three divergent spines at their apices. These are the first specimens of the type form which have been recorded with more than two spines on the processes, although three spines are generally found on the described varieties of this species.

Schmidle has recorded the var. *quadrangulare*, W. & G. S. West, from Victoria Nyanza, but no specimen I examined possessed the proportions of that variety.

Genus SPHÆROZOSMA, *Corda.*

138. SPHÆROZOSMA EXCAVATUM, *Ralfs, in Ann. Nat. Hist.* xvi. (1845) p. 15 ; *Brit. Desm.* (1848) p. 67, t. 6. fig. 2.

Nyasa.—Plankton, Anchorage Bay (11 June, 1904 ; no. 5).

Genus HYALOTHECA, *Ehrenb.*

139. HYALOTHECA MUCOSA, (*Dillw.*) *Ehrenb. in Bericht Berlin* (1840), p. 212 ; *Ralfs, Brit. Desm.* (1848) p. 53, t. 1. fig. 2.—Conferva mucosa, *Dillw.* (1819).

Tanganyika.—Plankton, Mbete (28 Sept. 1904 ; no. 105). Plankton, Lofu River (5 Oct. 1904 ; nos. 123 and 124), very abundant.

Order PROTOCOCCOIDEÆ.

Family **VOLVOCACEÆ.**

Genus PANDORINA, *Bory.*

140. PANDORINA MORUM, (*O. F. Müll.*) *Bory* ; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 99 ; *Cooke, Brit. Freshw. Alg.* t. 27. fig. 2.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

Family **CHARACIEÆ.**

Genus CHARACIUM, *A. Br.*

141. CHARACIUM LONGIPES, *Rabenh. Alg. Sachs.* no. 171 (1852) ; *Fl. Europ. Alg.* iii. (1868) p. 85.

Long. cell. 28·5–31 μ; lat. cell. 6–7 μ ; long. stip. 12·5–18 μ.

Victoria Nyanza.—Swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

142. CHARACIUM PRINGSHEIMII, *A. Br. Alg. Unicell.* p. 106 (1855); *Rabenh. l. c.* p. 86.

Long. cell. cum stip. brev. 34 μ ; lat. cell. 11 μ.

Victoria Nyanza.—Among *Utricularia,* near Entebbe (1 May, 1905 ; no. 620).

Family **PLEUROCOCCACEÆ.**

Genus TROCHISCIA, *Kütz.*

143. TROCHISCIA ACICULIFERA, (*Lagerh.*) *Hansg. in Hedgwigia,* xxvii. (1888), p. 129.—Acanthococcus aciculiferus, *Lagerh.*

Diam. cell. sine spin. 14 μ ; long. spin. 2·5 μ.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

Family **HYDRODICTYACEÆ.**

Subfam. PEDIASTREÆ.

Genus PEDIASTRUM, *Meyen.*

144. PEDIASTRUM TETRAS, (*Ehrenb.*) *Ralfs, in Ann. Nat. Hist.* xiv. (1844) p. 469, t. 12. fig. 4.—Micrasterias Tetras, *Ehrenb.*

Dispositio cellularum 4, 1 + 7, et 5 + 11.

Nyasa.—On shore, Domira Bay (19 June, 1904; no. 17). In swamp, Kota Kota (20 June, 1904; no. 18). Swampy lake margin, Domira Bay (no. 579).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Kituta (23 and 26 Aug. 1904; nos. 72 and 80). Floating on surface, Kituta Bay (26 Aug. 1904; no. 79). In swamp, Mbete (29 Sept. 1904; no. 108). Plankton, Lofu River (5 Oct. 1904; no. 123). Plankton, Baraka (24 Feb. 1905; no. 240).

From Nyasa (no. 17) a cœnobium was observed consisting of only three cells (Pl. **5.** fig. 6). This is a very interesting condition directly intermediate in character between the two-celled cœnobia of *Euastropsis* and the simple four-celled cœnobia of *Pediastrum.*

Var. LONGICORNE, *Racib.*

Diam. cœnob. 4 cell. (cum cornibus) 18–20 μ. (Pl. **5.** fig. 5.)

Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9).

145. PEDIASTRUM BORYANUM, (*Turp.*) *Menegh. Synops. Desm. in Linnæa,* xiv. (1840) p. 210; *Ralfs, Brit. Desm.* (1848) p. 187, t. 31. fig. 9 *a.*

Nyasa.—Plankton, Deep Bay (24 June, 1904; no. 25). In swamp, Kota Kota (20 June, 1894; no. 18).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Mbete (28 Sept. 1904; no. 108). Plankton, near Sumbu (13 Oct. 1904; no. 138). Plankton, near Kala (19 Nov. 1904; no. 170).

Var. RUGULOSUM, var. n. (Pl. **5.** fig. 22.)

Var. cellulis irregulariter cristatis, cristis valde irregularibus sinuatis et anastomosis.

Diam. cœnob. 150–192 μ; diam. cell. 22–29 μ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).

146. PEDIASTRUM INTEGRUM, *Näg. Gatt. einz. Alg.* (1849) p. 96, t. 5 B. fig. 4.

Diam. cœnob. 28–67 μ.

Tanganyika.—Plankton, near Mbete (28 Sept. 1904; no. 109). Plankton, near Kala (19 Nov. 1904; no. 170).

147. Pediastrum duplex, *Meyen, Beob. Algenf.* (1829) p. 772 ; *Lagerh. in Öfvers. K. Vet.-Akad. Förh.* (1882) no. 2, p. 56.—P. pertusum, *Kütz. Phyc. Germ.* (1845) p. 143 (ex parte). P. Napoleonis, *Ralfs, Brit. Desm.* (1848) p. 186, t. 31. fig. 7 *c, e.*

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Tanganyika.—Plankton, near Baraka (24 Feb. 1905 ; no. 240).

Forma cellulis centralibus ut in forma *rectangulari*, cellulis periphericis cum processibus divaricatis valde attenuatis ; membrana cellularum granulata.

Diam. cœnob. 160–235 μ ; diam. cell. 29–33 μ.

Victoria Nyanza.—Plankton, near Bukoba (20 Apr. 1905 ; no. 252).

This form resembles forma *cohærens*, Bohlin, and forma *rectangulare*, Bohlin (in Bih. K. Sv. Vet.-Akad. Handl. xxiii. no. 7 (1897), p. 31, t. 2. figs. 1–3), in the form of the central cells, but differs in its peripheral cells.

Var. clathratum, *A. Br. Alg. Unicell.* (1855) p. 93.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905 ; no. 252). Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

Tanganyika.—In swamp, Mbete (28 Oct. 1904 ; no. 108).

Var. reticulatum, *Lagerh. in Öfvers. K. Vet.-Akad. Förh.* (1882) no. 2, p. 56, t. 2. fig. 1.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; n. 620).

Tanganyika.—In swamp, Mbete (no. 108).

148. Pediastrum simplex, *Meyen, l. c.*; *Menegh. in Linnæa*, xiv. (1840) p. 212 ; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 71 ; *Wildeman, in Bull. de l'Herb. Boissier*, i. (1893) p. 412, t. 9 ; *Chodat, Algues Vertes de la Suisse* (1902), p. 225 c. fig.—P. simplex, *cf. Reinsch, Algenfl. Frank.* (1867) p. 88, t. 7. fig. 4 *a, b.* P. simplex α. compactum, *Chodat, l. c.*

Peripheral cells produced outwardly into a long attenuated process, *outer margins of cells concave* ; central cells polygonal, either without intercellular spaces, or with minute spaces between some or all of the cells. Processes radiating, generally rather delicate but sometimes stout, apices minutely truncate or nearly emarginate ; cell-walls commonly punctate and sometimes granulate.

Diam. cœnob. 44–92 μ ; diam. cell. 9–16 μ.

Nyasa.—Plankton, Anchorage Bay (13 and 14 June, 1904 ; nos. 9 and 10).

Tanganyika.—In plankton, near Chamkaluki (15 Nov. 1904 ; no. 160) and near Baraka (24 Feb. 1905 ; no. 240).

Forma Sturmii.—P. Sturmii, *Reinsch, l. c.* p. 90, t. 7. fig. I. P. Sturmii, *var.* radians, *Lemm. Forschungsb. Biol. Stat. Plön*, vii. (1899) p. 20.

Outer margins of peripheral cells *convex* ; central cells generally without intercellular spaces, but sometimes with small ones.

Diam. cœnob. 20–82 μ ; diam. cell. 8–17 μ.

Nyasa.—Plankton, Anchorage Bay (13 Apr. 1904 ; no. 9).

Victoria Nyanza.—Near Bukoba (17 Apr. 1905 ; no. 248). In sheltered bay, near Entebbe (1 May, 1905 ; no. 620).

Var. CLATHRATUM.—P. clathratum, (*Schröt.*) *Lemm. Forschungsb. Biol. Stat. Plön*, vii. (1899) p. 20 ; *Schmidle, in Engl. Bot. Jahrb.* xxxii. (1903) t. 3. fig. 19. P. enoplon, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 81, t. 5. figs. 1, 2.

With large intercellular spaces between the central cells ; outer margins of peripheral cells typically concave. Processes long and moderately robust.

Diam. cœnob. 100–180 μ ; diam. (max.) cell. 18–26 μ. (Pl. **2.** figs. 17, 18 ; Pl. **3.** fig. 16.)

Nyasa.—Plankton, off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905 ; no. 252).

—— forma RADIANS.—P. simplex, *var.* radians, *Lemm.* 1897; *Forschungsber. Biol. Stat. Plön*, vii. (1899) p. 19, t. 2. figs. 24, 25. P. simplex, β. annulatum, *Chodat*, 1902.

Cœnobium consisting of a ring of peripheral cells, the outer margins of which are concave ; no central cells.

Diam. cœnob. 46–75 μ. An abnormal cœnobium is figured on Pl. **5.** fig. 21.

Nyasa.—Plankton, Anchorage Bay (11 and 13 June, 1904 ; nos. 5 and 9). Plankton, off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—In sheltered bay, near Entebbe (1 May, 1905 ; no 620).

—— forma MICROPORUM.—P. clathratum, *var.* microporum, *Lemm. l. c.* p. 20, t. 2. figs. 29–31. P. clathratum, *var.* Baileyanum, *Lemm. l. c.* t. 2. figs. 26–28.

Peripheral cells of cœnobium as in typical var. *clathratum*, but central cells stouter with smaller intercellular spaces.

Diam. cœnob. usque ad 182 μ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905 ; no. 252).

—— forma OVATUM, (*Ehrenb.*).—P. Schröteri, *Lemm. l. c.* p. 20, t. 2. fig. 33, *et var.* microporum, *Lemm.* t. 2. figs. 34, 35. P. clathratum, *forma* ovatum, (*Ehrenb.*) *Schmidle, in Engl. Bot. Jahrb.* xxxii. (1903) p. 84, t. 3. fig. 18.

Central and peripheral cells ovoid and stout, margins generally convex (rarely slightly concave).

Diam. cœnob. usque ad 240 μ.

Nyasa.—Plankton, Anchorage Bay (13 and 14 June, 1904 ; nos. 9 and 10). Plankton, off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905 ; no. 252).

P. simplex occurred in great abundance in some of the plankton-material

and many diverse forms were observed. Extreme forms scarcely appear to belong to the same species, but a careful comparison of all the forms gives almost a complete gradation from one extreme to the other. Most of these forms have at different times been described under various specific names; but after examining the African plankton-forms it is impossible to recognize more than one species, and for the specific name I have retained Meyen's old name *Pediastrum simplex.* This name is a very appropriate one, as there is no other species of the genus with a simple radiating process from each peripheral cell.

In any of the forms the cell-wall may be smooth, punctate, or granulate, and the processes may be obtuse, truncate, or minutely emarginate.

In one most interesting form the cœnobium was not plane, the cells being disposed in the manner of a somewhat simplified *Cœlastrum.* Some of these cells possessed only one process and others two, and one of them appeared to be a resting akinete (Pl. **5**. fig. 20). This form was from Victoria Nyanza (no. 620): diam. cœnob. 40–46 μ; diam. cell. 10–17 μ. It should be compared with *Cœlastrum cornutum,* Lemaire (in Journ. de Bot. févr. (1894) pp. 82, 83 cum fig.), and also with *Pediastrum Kawraiskyi,* Schmidle (Algen Hochseen Kaukasus, 1897, p. 5; Lemm. in Ber. Deutsch. Bot. Ges. xix. (1901) t. 4. fig. 5).

Family **PROTOCOCCACEÆ (or AUTOSPORACEÆ).**

Subfam. CŒLASTREÆ.

Genus CŒLASTRUM, *Näg.*

149. CŒLASTRUM MICROPORUM, *Näg. ex A. Br. Alg. Unicell.* (1855) p. 70; *Rabenh. Fl. Europ. Alg.* iii. 1868, p. 80.

Diam. cœnob. 38–90 μ; diam. cell. 11·5–27 μ.

Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252).

150. CŒLASTRUM SPHÆRICUM, *Näg. Gatt. einz. Alg.* (1849) p. 97, t. 5 C. fig. 1 *a–d.*

Nyasa.—Plankton, Anchorage Bay (13 June, 1904; no. 9). Swampy lake margin, Domira Bay (19 June, 1904; no. 579). In swamp, Kota Kota (20 June, 1904; no. 18).

Victoria Nyanza.—Among *Utricularia,* near Entebbe (1 May, 1905; no. 620).

151. CŒLASTRUM CAMBRICUM, *Arch. in Micr. Journ.* (1868) p. 65; *Cooke, Brit. Freshw. Alg.* (1882) p. 46; *Lemaire, in Journ. de Bot.* no. 4, févr. (1894) pp. 79, 80 (cum fig.).—C. cambricum, *var.* quinqueradiatum, *Lemaire,* 1894. C. pulchrum, *Schmidle, in Ber. Deutsch. Bot. Ges.* x. (1892) p. 206, t. 11. fig. 1; *in Ber. d. Nat. Ges. Freiburg,* vii. (1893) p. 12, t. 2. fig. 10; *Bohlin, in Bih. K. Sv. Vet.-Akad. Handl.* xxii. (1897) no. 7, p. 35.

Nyasa.—Plankton, Anchorage Bay (14 June, 1904; no. 10).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80). In swamp, Mbete (28 Sept. 1904; no. 108).

Victoria Nyanza.—Near Entebbe (1 May, 1905; no. 620).

This species was abundant in some of the collections, and the cells showed great variation in the form of the external margin. It is a very characteristic plant and should not be confused with any other species of the genus. Lemaire's "var. *quinqueradiatum*" is one of its commonest forms.

Var. INTERMEDIUM, (*Bohlin*) *nob.*—C. pulchrum, *Schmidle, var.* intermedium, *Bohlin, in Bih. K. Sv. Vet.-Akad. Handl.* xxii. (1897) no. 7, p. 35, t. 2. figs. 16, 17. C. cruciatum, *Schmidle, in Bot. Centralbl.* lxxxi. (1900) no. 13.

Diam. cœnob. usque ad 108 μ; diam. cell. 13–16 μ.

Nyasa.—Plankton, Anchorage Bay (14 June, 1904; no. 10).

The cells of this variety, as in the case of the type, possess from four to six short radiating processes. The variety only differs in the bluntness of the outstanding projections, which are rounded and not truncate.

Var. NASUTUM, (*Schmidle*) *nob.*—C. pulchrum, *var.* nasutum, *Schmidle, in Engl. Bot. Jahrb.* xxvi. (1898) p. 6; xxxii. (1903) p. 85, t. 3. fig. 7.

Diam. cœnob. 40–114 μ; diam. cell. 8–27 μ; long. process. margin. 4·5–6·5 μ.

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905; no. 249).

This well-marked variety occurred abundantly, and a large number of auto-colonies were observed in process of formation in the mother-cells. The principal feature of the variety could be recognized when the auto-colonies were only 18 μ in diameter. The marginal processes were sometimes truncate and sometimes broadly rounded. It was originally described from the plankton of Victoria Nyanza by Schmidle in 1898.

152. CŒLASTRUM COMPOSITUM, sp. n. (Pl. **5**. figs. 8–9.)

C. cœnobiis cubicis e subfamiliis 8 formatis vel sphæricis e subfamiliis pluribus formatis; subfamilia unaquaque tetraëdrica cum angulis abrupte truncatis vel depresso-pyramidatis, e cellulis parvis 4 tetraëdrica dispositis compositis, et cum lacuna minuta inter cellulas; lacunis magnis inter subfamilias, iis cœnobiorum cubicorum irregulariter rotundo-rectangularibus, iis cœnobiorum sphæricorum subtriangularibus. Membrana cellularum firma glabra et non incrassata.

Diam. cœnob. 36–82 μ; diam. cell. 6–10 μ.

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

This interesting *Cœlastrum* differs from all other species of the genus in having a tetrahedral group of four cells in place of what would normally be a single cell. The interstices between the groups are very large, and there is

also a small intercellular space between the four cells of each group. The abruptly truncate external angles of the cells are also peculiar.

I have not seen any stage in the formation of auto-colonies in this species; such a condition should be of great interest.

153. Cœlastrum reticulatum, (*Dang.*) *Senn.* — Hariotina reticulata, *Dang. in Le Botaniste*, i. (1889) p. 162; *Chodat, Alg. Vert. Suisse*, i. (1902) p. 233. C. subpulchrum, *Lagerh. in La Nuova Notarisia* (1893), p. 158; *Bohlin, in Bih. K. Sv. Vet.-Akad. Handl.* xxiii. (1897) no. 7, p. 37, t. 2. figs. 28–32. C. distans, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 161, t. 21. fig. 18.

Diam. cœnob. usque ad 132 μ.

Nyasa.—In shore pools, Nkata Bay (23 June, 1904; no. 22). Plankton, off Vahambwera Point (24 June, 1904; no. 24) and in Deep Bay (24 June, 1904; no. 25). In swamp, Karonga (2 July, 1904; no. 33).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905; no. 252). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Some of the specimens reached a large size, and the reticulate colonies were a conspicuous feature of the plankton.

Genus SORASTRUM, *Kütz.*

154. Sorastrum Hathoris, (*Cohn*) *Schmidle, in Engl. Bot. Jahrb.* xxvii. (1899) p. 230; xxxii. (1903) p. 85.—Selenosphærium Hathoris, *Cohn*, '*Desm. Bongoenses,*' *Festschr. zur Feier des hundertjähr. Bestehens der Naturf. Ges. in Halle-a-S.* (1879) p. 13, t. 11. figs. 16, 17.

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905; no. 249).

Subfam. Crucigenieæ.

Genus CRUCIGENIA, *Morren.*

155. Crucigenia tetracantha, sp. n. (Pl. **5**. fig. 7.)

Cœnobium quadratum, e cellulis 4 formatum consociatum; cellulæ subquadratæ, lateribus subrectis, ad angulum exteriorum spina longa valida attenuata leviter curvata ornatæ, apicibus spinorum acutissimis; pyrenoide singulo in cellula unaquaque.

Diam. cœnob. sine acul. 17–19 μ; diam. cell. 9 μ; long. acul. 17–18 μ.

Tanganyika.—Plankton, near Baraka (24 Feb. 1905; no. 240).

This species is, perhaps, nearest to *C. heteracantha*, Nordst., but is at once distinguished by the large solitary spine at the external angle of each of the four cells. It bears considerable resemblance to a four-celled colony of some forms of *Pediastrum simplex*. There is a minute space in the centre of the cœnobium between the four cells, and there appeared to be a complete absence of a mucous envelope. The spines are hollow, greatly attenuated, and their apices drawn out into very sharp points. The single pyrenoids in each cell were conspicuous.

Subfam. SELENASTREÆ.

Genus SCENEDESMUS, *Meyen.*

156. SCENEDESMUS BIJUGATUS, (*Turp.*) *Kütz. Synops. Diat.* (1834).—Achnanthes bijuga, *Turp.*, 1828. Scenedesmus obtusus, *Meyen*, 1829.

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Tanganyika.—Plankton, off Niamkolo Island (29 July, 1904 ; no. 36). On the stones of the shore, Niamkolo (3 Aug. 1904 ; no. 44). Plankton, Komba Bay (11 Oct. 1904 ; no. 135) and near Sumbu (13 Oct. 1904 ; no. 138). In swamp, Toa (10 Jan. 1905 ; no. 208).

Forma ARCUATA, (*Lemm.*) *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxiii. sect. B (1906), p. 105, t. 10. figs. 12–14.—Scenedesmus arcuatus, *Lemm. in Forschungsb. Biol. Stat. Plön*, vii. (1899) p. 17, t. 1. figs. 2–4.

Tanganyika.—Plankton, Komba Bay (11 Oct. 1904 ; no. 135) and near Chamkaluki (15 Nov. 1904 ; no. 160).

This form appears to be frequent in the plankton. Several colonies were observed (from no. 160) attached together to form a curved plate of oblong cells, which greatly resembled a colony of *Crucigenia rectangularis*, (Näg.) F. Gay, var. *irregularis*, (Wille) nob.

157. SCENEDESMUS DENTICULATUS, *Lagerh. in Öfvers. K. Sv. Vet.-Akad. Förh.* (1882) no. 2, p. 61, t. 2. figs. 13–16.

Var. LINEARIS, *Hansg. in Archiv Naturwiss. Landesdurchf. Böhm.* vi. (1888) no. 6, p. 268.—S. denticulatus, *var.* lineatus, *West, in Journ. Linn. Soc., Bot.* xxix. (1892) p. 193, t. 18. fig. 7.

Nyasa.—On stones on shore, Domira Bay (19 June, 1904 ; no. 17). In swamp, Kota Kota (20 June, 1004 ; no. 18). In swamp, Karonga (2 July, 1904 ; no. 34).

Tanganyika.—Plankton, Lofu River (5 Oct. 1904 ; no. 123).

158. SCENEDESMUS ACUTIFORMIS, *Schröder, in Forschungsb. Biol. Stat. Plön*, v. (1897) p. 17, t. 2. f. 4.

Nyasa.—In pools, Nkata Bay (23 June, 1904 ; no. 22). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Var. BRASILIENSIS, (*Bohlin*) *W. & G. S. West, in Trans. Bot. Soc. Edinb.* xxiii. (1905) p. 30, t. 1. figs. 8, 9.—S. brasiliensis, *Bohlin, in Bih. K. Sv. Vet.-Akad. Handl.* xxiii. (1897) no. 7, p. 22, t. 1. figs. 26–27. S. acutiformis, *Schröd. var.* spinulifer, *W. & G. S. West, in Bot. Tidsskr.* xxiv. (1901) p. 182, t. 4. figs. 46–49.

Nyasa.—On rocks and in shore-pools, Nkata Bay (23 June, 1904 ; nos. 22

and 23). Among other Algæ in scrapings off the bottom of s.s. 'Guendolen,' at anchor at S. end of the lake (15 June, 1904 ; no. 577).

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72). Plankton, near Sumbu (13 Oct. 1904 ; no. 138) and near Kala (19 Nov. 1904 ; no. 170).

159. SCENEDESMUS OBLIQUUS, (*Turp.*) *Kütz. Synops. Diat.* (1834) p. 609.—Achnanthes obliqua, *Turp.*, 1828. Scenedesmus acutus, *Meyen*, 1829 ; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 64.

Nyasa.—On stones on shore, Domira Bay (19 June, 1904 ; no. 17). Shore-pools, Nkata Bay (23 June, 1904 ; no. 22).

Tanganyika.—Plankton, Lofu River (5 Oct. 1904 ; no. 123).

160. SCENEDESMUS QUADRICAUDA, (*Turp.*) *Bréb. Alg. Falais.* p. 66 (1835).—Achnanthes quadricauda, *Turp.*, 1828. Scenedesmus caudatus, *Corda*, 1838 ; *Ralfs. Brit. Desm.* (1848) p. 190, t. 31. fig. 12 *a–g*.

Nyasa.—Plankton, Anchorage Bay (13 June, 1904 ; nos. 5 and 9). On shore, Domira Bay (19 June, 1904 ; no. 17). Shore-pools, Nkata Bay (23 June, 1904 ; no. 22). In swamp, Kota Kota (20 June, 1904 ; no. 18). In swamp, Karonga (2 July, 1904 ; no. 33). S. end of lake (no. 577). Swampy lake margin, Domira Bay (no. 579).

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108). Plankton, Kituta Bay (26 Aug. 1904 ; no. 81), near Kala (19 Sept. 1904 ; no. 170), near Kirando (1 Dec. 1904 ; no. 175), near Maswa (14 Jan. 1905 ; no. 211), and near Baraka (24 Feb. 1905 ; no. 240).

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618). Sheltered bay near Entebbe (1 May, 1905 ; no. 620).

Var. MAXIMUS, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 83, t. 5. figs. 9, 10.

Nyasa.—In swamp, Karonga (2 July, 1904 ; nos. 33 and 34).

Tanganyika.—In plankton, near Sumbu (13 Oct. 1904 ; no. 138), near Chamkaluki (15 Nov. 1904 ; no. 160), near Kala (19 Nov. 1904 ; no. 170), off Kirando (1 Dec. 1904 ; no. 175), and near Baraka (24 Feb. 1905 ; no. 240).

Victoria Nyanza.—In plankton, near Bukoba (18 Apr. 1905 ; no. 249). Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

Some of the cœnobia were very large, up to 54 μ in length (cœnob. of 4 cells) ; length of cells 42 μ. The variety was originally described from Madagascar.

Var. OPOLIENSIS, (*Richt.*) *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* vi. (1902) p. 197, t. 17. figs. 16, 17.—S. opoliensis, *Richter*, 1895.

Tanganyika.—Abundant in swamp, Mbete (28 Sept. 1904 ; no. 108).

Genus DIMORPHOCOCCUS, *A. Br.*

161. DIMORPHOCOCCUS LUNATUS, *A. Br. Alg. Unicell.* (1855) p. 44 ; *Rabenh. Fl. Europ. Alg.* iii. (1868) pp. 6 (cum fig.) et 35 ; *West, in Journ. Roy. Micr. Soc.* (1892) p. 735, t. 9. fig. 39.—Scenedesmus radiatus, *Reinsch.*

Diam. colon. usque ad 104 μ ; long. cell. 14–16 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905 ; no. 249).

Genus ANKISTRODESMUS, *Corda.*

162. ANKISTRODESMUS FALCATUS, (*Corda*) *Ralfs, Brit. Desm.* (1848) p. 180, t. 34. fig. 3.—Micrasterias falcata, *Corda*, 1835. Ankistrodesmus fusiformis, *Corda*, 1838 (ex parte). Rhaphidium fasciculatum, *Kütz.*, 1845. R. polymorphum, *Fresen.*, *var.* falcatum, *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 45.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Tanganyika.—Plankton, Lofu River (5 Oct. 1904 ; no. 123).

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618). Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

a. Forma cellulis robustis lunatis, chromatophora cum pyrenoide singulo. Lat. cell. 5 μ.

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18).

b. Forma cellulis robustis rectis solitariis, leviter tumidis, sine pyrenoidibus. Lat. cell. 7 μ.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 24).

Var. ACICULARIS, (*A. Br.*) *G. S. West, Treat. Brit. Freshw. Alg.* (1904) p. 223.—Rhaphidium aciculare, *A. Br. in Rabenh. Alg.* 1849, no. 442. Ankistrodesmus acutissimus, *Arch. in Journ. Micr. Sci.* 1862, p. 255, t. 12. figs. 44–57.

Nyasa.—On stones on shore, Domira Bay (19 June, 1904 ; no. 17). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Var. SPIRILLIFORMIS, *G. S. West, l. c.* (1904) p. 224.—Rhaphidium polymorphum, *var.* spirale, *W. & G. S. West, in Journ. Bot.* xxxvi. (1898) p. 335.

Tanganyika.—Plankton, near Kala (19 Nov. 1904 ; no. 170).

163. ANKISTRODESMUS NITZSCHIOIDES, sp. n. (Pl. **5**. fig. 18.)

A. cellulis solitariis, elongatis, fusiformibus, ad polum unumquemque in spinam longissimam tenuissimam valde attenuatis, extremitatibus spinarum curvatis (extremitati spinæ alterius poli cum ea alterius curvato in directione opposita); chromatophora pallide viridi, pyrenoidibus nullis.

Long. cell. cum spin. 116–126 μ ; lat. cell. in med. 3·6–4 μ.

Tanganyika.—Plankton, near Chamaluki (15 Nov. 1904 ; no. 160).

This species stands nearest to *A. setigerus*, (Schröd.) G. S. West (*Reinschiella? setigera*, Schröd. in Ber. Deutsch. Bot. Ges. xv. (1897) p. 492, t. 25.

fig. 4), but is distinguished by its narrower cells, its stouter and curved spines, and by the absence of pyrenoids from the chloroplast.

It bears considerable resemblance to certain small and attenuated species of the genus *Nitzschia*.

Genus CLOSTERIOPSIS, *Lemm.*

164. Closteriopsis longissima, *Lemm. in Forschungsb. Biol. Stat. Plön*, vii. (1899) p. 29, t. 2. figs. 36–38 ; *W. & G. S. West, in Trans. Roy. Irish Acad.* xxxiii. sect. B (1906), p. 106, t. 10. figs. 17–19.

Nyasa.—Plankton, Deep Bay (24 June, 1904 ; no. 25) and off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905 ; no. 249).

Genus SELENASTRUM, *Reinsch.*

165. Selenastrum gracile, *Reinsch, in Abh. Natur. Ges. Nürnb.* iii. Heft 2 (1867), p. 65, t. 4. fig. 3.

Diam. colon. usque ad 154 μ ; crass. cell. 4–5 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

Victoria Nyanza.—Plankton, near Bukoba (21 Apr. 1905 ; no. 252). Some of the colonies were of very large size.

Genus KIRCHNERIELLA, *Schmidle.*

166. Kirchneriella obesa, (*West*) *Schmidle, in Flora*, lxxvii. (1894) p. 44.—Selenastrum obesum, *West, in Journ. Roy. Micr. Soc.* (1892) p. 734, t. 10. figs. 50–52.

Tanganyika.—In swamp, Kituta (26 Aug. 1904 ; no. 80).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905 ; no. 252).

Subfam. Oocystideæ.

Genus OOCYSTIS, *Näg.*

167. Oocystis solitaria, *Wittr. in Wittr. & Nordst. Alg. Exsic.* fasc. v. (1879) no. 244 ; *Bot. Notiser* (1879), p. 24.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

168. Oocystis parva, *W. & G. S. West, in Journ. Bot.* xxxvi. (1898); *G. S. West, l. c.* xxxvii. (1899) t. 394. figs. 14–17.

Nyasa.—Plankton, Monkey Bay (17 June, 1904 ; no. 15).

169. Oocystis lacustris, *Chodat, in Bull. Herb. Boiss.* v. (1897) p. 296 ; *Algues Vertes de la Suisse* (1902), p. 190.

Long. colon. 39–54 μ ; long. cell. 12–20 μ ; lat. cell. 7–13 μ.

Nyasa.—Plankton, Anchorage Bay (13 June, 1904 ; no. 9).

Tanganyika.—Plankton, off Niamkolo (July and Aug. 1904 ; nos. 36 and 39), near Mbete (28 Sept. 1904 ; no. 109), Vua Harbour (29 Oct. 1904 ; no. 150), near Kalambo (5 Nov. 1904 ; no. 154), near Chamkaluki (15 Nov. 1904 ; no. 160), near Kala (19 Nov. 1904 ; no. 170), near Kirando (1 Dec. 1904 ; no. 175), in middle of lake crossing from Rumonge to Uvira (30 Jan. 1905 ; no. 218), near Ndauvie (7 Feb. 1905 ; no. 227), and near Baraka (24 Feb. 1905 ; no. 240).

Victoria Nyanza.—Plankton, near Bukoba (18 Apr. 1905 ; no. 249).

This Alga was very frequent in the plankton, especially of Tanganyika. The envelope surrounding the colonies is always very hyaline, and no colonies were observed of more than eight cells. The faint apiculus at each pole is very characteristic, although exceedingly slight. Two chloroplasts were generally present in each cell. The plants observed were identical in every respect with those which occurred in the plankton of certain Irish lakes (*vide* Trans. Roy. Irish Acad. xxxiii. sect. B, 1906, p. 107).

Genus NEPHROCYTIUM, *Näg.*

170. Nephrocytium Agardhianum, *Näg. Gatt. einz. Alg.* (1849) p. 79, t. 3 c. figs. *a–p*.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

Tanganyika.—In swamp, Kituta (23 & 26 Aug. 1904 ; nos. 72 and 80).

171. Nephrocytium lunatum, *West, in Journ. Roy. Micr. Soc.* (1892) p. 736, t. 10. fig. 49.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

Subfam. Tetraëdreæ.

Genus TETRAËDRON, *Kütz.*

172. Tetraëdron trigonum, (*Näg.*) *Hansg. in Hedwigia*, xxvii. (1888) p. 130.—Polyedrium trigonum, *Näg. Gatt. einz. Alg.* (1849) p. 84, t. 4 b. fig. 1.

Diam. cell. sine spin. 14–16 μ ; long. spin. 5–6·5 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

173. Tetraëdron minimum, (*A. Br.*) *Hansg. l. c.* p. 131.—Polyedrium minimum, *A. Br. in Rabenh. Fl. Europ. Alg.* iii. (1868) p. 62.

Trigonal forms : **Nyasa.**—In scrapings from bottom of s.s ‘Guendolen’ at anchor S. end of lake (15 June, 1904 ; no. 577). In swamp, Karonga (2 July, 1904 ; no. 34).

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36). In swamp, Toa (10 Jan. 1905 ; no. 168).

174. Tetraëdron regulare, *Kütz. Phyc. Germ.* (1845) p. 129.—Polyedrium tetraëdricum, *Näg. Gatt. einz. Alg.* (1849) p. 84, t. 4 B. fig. 3.

Diam. cell. sine spin. 18–26 μ.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32, and 2 July, 1904; no. 34).

175. Tetraëdron lobulatum, (*Näg.*) *Hansg. in Hedwigia*, xxvii. (1888) p. 132.—Polyedrium lobulatum, *Näg. Gatt. einz. Alg.* (1849) p. 84, t. 4 B. fig. 4.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

176. Tetraëdron bifurcum, (*Wille*) *Lagerh. in Nuova Notarisia* (1893), p. 160.—Polyedrium trigonum β. bifurcum, *Wille, in Bih. K. Sv. Vet.-Akad. Handl.* viii. (1884) no. 18, p. 12, t. 1. fig. 24.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905; no. 618).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Genus CERASTERIAS, *Reinsch.*

177. Cerasterias rhaphidioides, *Reinsch, in Abh. Naturh. Ges. Nürnb.* iii. (1867) p. 68, t. 5. fig. 1.

Diam. cell. (cum radiis) 48–60 μ.

Tanganyika.—Plankton, near Chamkaluki (15 Nov. 1904; no. 160) and near Kala (19 Nov. 1904; no. 170).

Subfam. PhytheliEæ.

Genus RICHTERIELLA, *Lemm.*

178. Richteriella botryoides, (*Schmidle*) *Lemm. in Hedwigia*, xxxvii. (1898) p. 306, t. 10. figs. 1–6.—Golenkinia botryoides, *Schmidle.* Richteriella globosa, *Lemm.*

Forma quadriseta, (*Lemm.*) *Chodat*, 1902.—R. quadriseta, *Lemm. l. c.* p. 307, t. 10. fig. 7.

Tanganyika.—Plankton, near Kala (19 Nov. 1904; no. 170).

Genus CHODATELLA, *Lemm.*

179. Chodatella subsalsa, *Lemm. in Hedwigia*, xxxvii. (1898) p. 310.—Lagerheimia subsalsa, *Lemm. in Forschungsb. Biol. Stat. Plön*, vi. (1898) t. 5. figs. 2–6.

Long. cell. (sine acul.) 5–13 μ; lat. cell. 2·5–8·5 μ; long. acul. 7·5–26 μ.

Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170).

This Alga was fairly frequent in one of the plankton collections from Tanganyika (no. 170), but was not observed from any of the others. The

cells attained slightly larger dimensions than those described by Lemmermann from Germany. The three spine-like bristles at each pole were frequently bent and usually widely spreading.

Subfam. Dictyosphærieæ.

Genus DICTYOSPHÆRIUM, *Näg.*

180. Dictyosphærium pulchellum, *Wood, Freshw. Alg. U. S.* (1874) p. 84, t. 10. fig. 4.

Nyasa.—In plankton, Anchorage Bay (11 June, 1904 ; no. 5).

Tanganyika.—In plankton, near Chumkaluki (15 Nov. 1904 ; no. 160) and near Kala (19 Nov. 1904 ; no. 170).

Victoria Nyanza.—In plankton, near Bukoba (18 Apr. 1905 ; no. 249). In swampy pool near Bukoba (20 Apr. 1905 ; no. 618).

Genus TETRACOCCUS, *West.*

181. Tetracoccus botryoides, *West, in Journ. Roy. Micr. Soc.* (1892) p. 735, t. 10. figs. 43–48.

Diam. colon. 56–84 μ ; diam. cell. 4–8 μ.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36), Komba Bay (11 Oct. 1904 ; no. 135), and near Kala (19 Nov. 1904 ; no. 170).

Genus BOTRYOCOCCUS, *Kütz.*

182. Botryococcus Braunii, *Kütz. Sp. Alg.* (1849) p. 892 ; *Rabenh. Fl. Europ. Alg.* iii. (1868) p. 42, fig. 14 ; *Chodat, in Morot, Journ. de Bot.* x. (1896) p. 303, t. 3.

Nyasa.—In plankton, Monkey Bay (17 and 18 June, 1904 ; nos. 15 and 16); also off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30).

Tanganyika.—In plankton, Utinta (5 Dec. 1904 ; no. 181).

Victoria Nyanza.—In plankton, near Bukoba (20 and 21 Apr. 1905 ; nos. 250 and 252).

The large colonies of this Alga formed in some instances a yellow scum on the surface of the water. This was due to the appearance of the brick-red pigment which at certain seasons gives the colonies a decided yellow or yellowish-red colour and causes a corresponding coloration of the water.

Genus INEFFIGIATA, *W. & G. S. West.*

183. Ineffigiata neglecta, *W. & G. S. West, in Journ. Roy. Micr. Soc.* (1897) p. 503 ; *W. & G. S. West, in Journ. Bot.* xli. (1903) p. 80, t. 447. figs. 1–6.

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).

This Alga requires further investigation. The tough membrane which encloses the families of cells, and irregular lobes and strands of which hold the colonies together, seems to distinguish it from *Botryococcus Braunii*. It may, however, be only a state of that Alga. All the specimens from Victoria Nyanza had the prickly appearance which is often one of the peculiarities of *Ineffigiata* (*vide* W. & G. S. West, in Journ. Bot. xli. (1903) t. 447. fig. 3), the tough outer membrane being densely covered with irregular spines and spinous processes.

Family **PALMELLACEÆ.**

Genus PALMOPHYLLUM, *Kütz.*

184. Palmophyllum foliaceum, sp. n. (Pl. **5**. fig. 10.)

Thallus minutus, cartilagineus, subcrassus, foliaceo-lobatus, basin angustiorem fixus, sine lineis concentricis, lobis sinuatis ; cellulis minutissimis, confertissimis, in lineis longitudinaliter dispositis, oblongis vel oblongo-ellipticis, viridibus. Cellularum divisio in unam directionem.

Long. thall. 250–330 μ ; lat. max. thall. 140–320 μ ; long. cell. 2·2–3·4 μ ; lat. cell. 1·3–1·6 μ.

Tanganyika.—On stones, dredged in a few fathoms, Niamkolo ; among *Cladophora inconspicua* in the hollows of a calcareous incrustation.

This species is distinguished from *P. crassum*, (Nacc.) Rabenh. (=*P. flabellatum*, Kütz.) by the smaller size of the thallus, which is destitute of the zones of concentric lines, and by the minute cells. The thallus is expanded from a narrow base and is of uneven thickness. It is of a dark green colour, lobed and sinuate at the margin, and sometimes deeply cleft. The nature of the chloroplast could not be determined from the preserved (dried) material.

SPHINCTOSIPHON, gen. n.

Cellulæ in tegumentis tubulosis conferte et irregulariter aggregatæ ; tegumentis gelatinosis, achrois, tubulosis, firmis et lamellosis, lamellis externis sæpe diffluentibus ; cellulæ globosæ, cum chromatophora singula parietali læte viridi et valde granulosa ; membrana cellularum tenuissima ; tegumentis junioribus subrotundatis vel irregulariter lobatis, iis vetustis elongatis, siphoniformibus, curvatis, hinc inde ligatis. Propagatio divisione tegumentorum lobatorum juniorum in omnes directiones.

185. Sphinctosiphon polymorphus, sp. unica. (Pl. **3**. fig. 12 ; Pl. **5**. figs. 11–13.)

Character idem ac generis. Tegumentis adultis irregulariter cylindricis, vermiformibus, nunquam ramosis, sæpe in articulis elongatis constrictis vel subconstrictis.

Diam. teg. jun. 80–180 μ; diam. teg. adult. (vermiform.) 39–60 μ; diam. cell. 5·5–7·5 μ; crass. teg. 5–8 μ.

Victoria Nyanza.—In plankton, near Bukoba (18 and 21 Apr. 1905; nos. 249 and 252).

This peculiar genus stands nearest to *Palmodactylon*, Näg., but is at once distinguished by the hollow integuments with a firm outer gelatinous wall. If the Alga be subjected to slight pressure, the cells can be squeezed from one part of the hollow vermiform integument to another. The wall of the integument often shows a lamellose structure, and in the younger individuals the outer coats often become mucilaginous. In the young stages the thallus is rounded or irregularly lobed, and while in this condition it frequently divides, forming several more or less rounded segments, each of which then grows to form an adult plant. The adult thallus is very long, reaching a length of 2 mm., and it is more or less cylindrical and vermiform in appearance. It possesses slight irregular swellings and constrictions of variable depths at intervals, and is not infrequently segmented into several elongated joints. *Sphinctosiphon* does not appear to branch.

The exact nature of the chromatophore could not be determined from the preserved material. It is undoubtedly massive and occupies most of the cell, being for the greater part parietal in disposition.

Genus SPHÆROCYSTIS, *Chodat.*

186. Sphærocystis Schroeteri, *Chodat, in Bull. Herb. Boiss.* v. (1897) p. 292, t. 9.

Tanganyika.—In the plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

This Alga occurred in great abundance in the two collections of river-plankton and, curiously enough, it was not observed in the plankton of the lakes themselves. The colonies were the largest I have yet seen and reached a diameter of 240 μ. It is generally distributed in all the freshwater plankton of Europe.

Genus GLŒOCYSTIS, *Näg.*

187. Glœocystis gigas, *(Kütz.) Lagerh. in Öfvers. K. Sv. Vet.-Akad. Förh.* (1883) no. 2, p. 63.—Protococcus gigas, *Kütz. Phyc. Germ.* (1845) p. 145. Chlorococcum gigas, *(Kütz.) Grun.*

Nyasa.—In swamp, Kota Kota (20 June, 1904; no. 18). In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

A form with rather large cells and very tough, brownish or yellowish integuments occurred in the plantation from near Sumbu (13 Oct. 1904; no. 138).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

Class HETEROKONTÆ.

Order CONFERVALES.

Family **TRIBONEMACEÆ.**

Genus OPHIOCYTIUM, *Näg.*

188. Ophiocytium parvulum, *(Perty) A. Br. Alg. Unicell.* (1855) p. 55.—Brochidium parvulum, *Perty.*

Crass. cell. 4–5 μ.

Nyasa.—Among weeds and various Algæ, in swamp, Karonga (2 July, 1904; no. 34).

Class BACILLARIEÆ.

Order CENTRICÆ.

Family **MELOSIRACEÆ.**

Genus MELOSIRA, *Ag.*

189. Melosira nyassensis, *O. Müll. in Engl. Bot. Jahrb.* xxxiv. (1905) p. 285, t. 3. fig. 3.

Crass. fil. 22–33 μ. (Pl. **2.** figs. 6, 7; Pl. **3.** figs. 5, 26.)

Nyasa.—In plankton, Anchorage Bay (9–14 June, 1904; nos. 2, 5, 7, 9, and 10), and also off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—In plankton, off Bukoba (20 and 21 Apr. 1905; nos. 250 and 252).

This Diatom was the dominant feature of some of the plankton collections. It was described by O. Müller in 1895 from the plankton of Lake Nyasa and the waters of some of the surrounding areas. It may be regarded as one of the numerous forms of *Melosira granulata.*

190. Melosira granulata, *Ralfs, in Pritch. Infus.* ed. 4 (1861), p. 820.

Nyasa.—In plankton, Anchorage Bay (13 and 14 June, 1904; nos. 9 and 10).

Victoria Nyanza.—In plankton, near Bukoba (20 Apr. 1905; no. 250).

Var. angustissima, *O. Müll. l. c.* p. 285, t. 4. fig. 12.

Crass. fil. 3–4·5 μ.

Nyasa.—In plankton, Anchorage Bay (9–14 June, 1904; nos. 2, 7, 9, and 10), and also off Karonga (1 July, 1904; no. 30).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

This delicate variety was very abundant in some of the plankton collections, and unless cleaned and prepared specially for examination, was difficult to recognize as a *Melosira.* As compared with their diameter, the cells are relatively longer than in other forms of *M. granulata.*

Family **COSCINODISCACEÆ**.

Genus CYCLOTELLA, *Kütz.*

191. Cyclotella compta, (*Ehrenb.*) *Kütz. Sp. Alg.* p. 20 (1849).
Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905; no. 249).

192. Cyclotella Meneghiniana, *Kütz. Bacill.* p. 50 (1865).

Var. rectangulata, *Grun.*; *Van Heurck, Syn. Diat. Belg.* t. 94. figs. 17–19. Diam. valv. 15 μ.
Nyasa.—In scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904; no. 577).

193. Cyclotella operculata, *Kütz. l. c.*
Nyasa.—In plankton, Anchorage Bay (11–14 June, 1905; nos. 5, 9, and 10) and Monkey Bay (18 June, 1904; no. 16).
Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170).

194. Cyclotella Kützingiana, *Chauvin*; *Thw. in Ann. Mag. Nat. Hist.* ser. 2, i. (1848) p. 169; *Van Heurck, l. c.* t. 94. figs. 1, 46.
Nyasa.—In plankton, Anchorage Bay (14 June, 1905; nos. 9 and 10).
Tanganyika.—On surface of swamp, Toa (10 Jan. 1905; no. 208).
Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

Genus STEPHANODISCUS, *Ehrenb.*

195. Stephanodiscus Astræa, (*Ehrenb.*) *Grun. in Cleve & Grun. Arct. Diat.* 114 (1880); *Van Heurck, Syn. Diat. Belg.* (1885) t. 95. fig. 5.
Nyasa.—In plankton, Anchorage Bay (11–14 June, 1904; nos. 5, 9, and 10). On shore, Domira Bay (19 June, 1904; no. 17). On rocks, Nkata Bay (23 June, 1904; no. 23). In plankton, off Vahambwera Point (24 June, 1904; no. 24).

Some finely developed specimens of this Diatom were observed, the valves attaining a diameter of 81 μ.

Var. spinulosus, *Grun.*; *Van Heurck, l. c.* t. 95. fig. 6.
Nyasa.—In plankton, Anchorage Bay (14 June, 1904; no. 10); also Deep Bay (24 June, 1904; no. 25).

Var. minutulus, (*Kütz.*) *Grun.*; *Van Heurck, l. c.* t. 95. figs. 7, 8.—Cyclotella minutula, *Kütz.*
Nyasa.—In plankton, Anchorage Bay (11–14 June, 1904; nos. 5, 9, and 10).

Order PENNATÆ.

Family **FRAGILARIACEÆ.**

Genus FRAGILARIA, *Lyngb.*

196. Fragilaria virescens, *Ralfs, in Ann. Nat. Hist.* ser. 1, xii. (1843) p. 110, t. 2. fig. 6 ; *Rabenh. Fl. Europ. Alg.* i. (1864) p. 119.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904 ; no. 22).

197. Fragilaria æthiopica, sp. n. (Pl. **8.** fig. 1.)

Cellula ut visa aspectu valvulari subanguste elliptica, polis rotundatis, pseudorhaphide distincta sublata in centro stauriformi, costis lateralibus crassis glabris 11 utrobique, costa mediana brevi et rotundata ; ut visa aspectu cingulato quadrato-rectangularis, apicibus truncatis, lateribus levissime retusis in medio et cum costis crassis 11. Cellulæ ut visæ solitariæ.

Long. valv. 17–19·5 μ ; lat. valv. 7·5–8 μ.

Tanganyika.—On stones, submerged roots, grasses, etc., Niamkolo (1 Aug. 1904 ; no. 44).

This species is readily distinguished by its few, broad costæ. The valve-view is somewhat narrowly elliptic, and there are eleven broad smooth costæ on each side, extending towards the central line, but leaving a fairly broad pseudoraphe. In the centre the pseudoraphe widens out forming a stauros, the median costa on each side being correspondingly short. The costæ are not transverse, but exhibit a decided radiation near the median part of the valve. In the girdle-view the cell is quadrate-rectangular and the costæ show very plainly along each lateral margin.

F. æthiopica belongs to the section '*Staurosira*, Ehrenb.'

Genus SYNEDRA, *Ehrenb.*

198. Synedra Nyansæ, sp. n. (Pl. **8.** fig. 3.)

Cellula ut visa aspectu valvulari robusta, linearis, diametro $6\frac{1}{2}$–$13\frac{1}{2}$-plo longior, marginibus lateralibus parallelis, subiter attenuata apices versus, apicibus productis et subcapitato-rostratis, pseudorhaphide recta magna et conspicua (usque 4 μ lata), striis 14–15 in 10 μ ; ut visa aspectu cingulato linearis, apicibus rectangularibus.

Long. valv. 91–150 μ ; lat. valv. 10–13 μ ; lat. apic. 3·2–3·8 μ.

Victoria Nyanza.—Among Algæ on rocks below the water-level, Bukoba (17 Apr. 1905 ; no. 248).

This species resembles in outline *S. Ulna*, (Nitzsch) Ehrenb., and *S. oxyrhynchus*, Kütz., but differs in its much finer striations, its broader and more conspicuous pseudoraphe, as well as in the absence of the clear space in the median part of the valves.

In its general proportions it was somewhat variable, and some very short, robust individuals were observed.

199. Synedra Ulna, (*Nitzsch*) *Ehrenb. Infus.* (1838) p. 211, t. 17. fig. 1; *Rabenh. Fl. Europ. Alg.* i. (1864) p. 133.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 123). In swamp, Toa (10 Jan. 1905; no. 208).

Victoria Nyanza.—In swampy pool, near Bukoba (20 Apr. 1905; no. 618).

Var. splendens, (*Kütz.*) *Van Heurck.*—S. splendens, *Kütz. Bacill.* (1844) p. 66, t. 14. fig. 16. S. radians, *W. Sm. Brit. Diat.* i. p. 71.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; nos. 123 and 124).

200. Synedra pulchella, *Kütz. Bacill.* (1844) p. 68, t. 29. fig. 37; *W. Sm. Brit. Diat.* i. p. 70, t. 11. fig. 84.

Tanganyika.—Floating on surface of water, Kituta Bay (26 Aug. 1904; no. 79). In swamp, Mbete (28 Sept. 1904; no. 108).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

201. Synedra Acus, *Kütz. Bacill.* (1844) p. 68, t. 15. fig. 7; *Rabenh. Fl. Europ. Alg.* i. (1864) p. 136.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Tanganyika.—In plankton, near Kirando (1 Dec. 1904; no. 175).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Var. delicatissima, (*W. Sm.*) *Grun.*—S. delicatissima, *W. Sm.*

Nyasa.—In plankton, Anchorage Bay (9 June, 1904; no. 2, and 13 June, 1904; no. 9), and Monkey Bay (18 June, 1904; no. 16). S. end of lake (15 June, 1904; no. 577).

Tanganyika.—In plankton, off Niamkolo (29 July, 1904; no. 36, and 9 Aug. 1904; no. 53). In swamp, Kituta (26 Aug. 1904; no. 80). In plankton, Mbete (28 Sept. 1904; no. 109), Komba Bay (11 Oct. 1904; no. 135), Vua Harbour (29 Oct. 1904; no. 150), near Kassanga (14 Nov. 1904; no. 159), and near Chamkaluki (15 Nov. 1904; no. 160). This variety was particularly abundant from no. 109.

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

Var.? (=Synedra revaliensis, *Lemm. ex W. & G. S. West, in Trans. Roy. Irish Acad.* xxxiii. (1906) sect B, p. 110.)

Long. 85–94 μ; lat. 2–2·5 μ.

Tanganyika.—In plankton, near Kasawa, near Kirando (1 Dec. 1904; no. 175), near Utinta (5 Dec. 1904; no. 181), near Maswa (14 Jan. 1905; no. 211), in middle of lake between Rumonge and Uvira (30 Jan. 1905; no. 218), and near Ndauvie (7 Feb. 1905; no. 227).

I am not quite certain of this determination, as I have not seen a published description or figure of Lemmermann's species. [Since this was written Lemmermann's description of *S. revaliensis* has appeared in Ber. Deutsch. Bot. Ges. xxiv. (1906) p. 536.] It agrees, however, with

specimens of a *Synedra* from the Irish Lakes which were referred by Lemmermann to *S. revaliensis*. It seems to be identical with the *Synedra* mentioned by Ostenfeld and Wesenberg-Lund as occurring in two Icelandic lakes (*vide* Proc. Roy. Soc. Edinb. xxv. part xii. (1906) p. 1114, t. 2. figs. 16, 17); and I am inclined to agree with those authors that it is merely a form of *S. Acus* var. *delicatissima*, the stellate colonies resulting from an adaptation to a limnetic life. Some of the radiating colonies contained upwards of 50 individuals. It may also be identical with the Diatom recorded by Schmidle from Lake Nyasa as "*Synedra ? asterionelloides*, O. Müller, n. sp." (*cf.* Engl. Bot. Jahrb. xxxiii. (1902) p. 8).

In both this Diatom and the succeeding species (*S. actinastroides*) the individuals are arranged in radiating colonies after the manner of the genus *Actinastrum*, and Lemmermann places them along with the two species *S. limnetica*, Lemm., and *S. berolinensis*, Lemm., in a subgenus "*Belonastrum*" of *Synedra*.

202. SYNEDRA ACTINASTROIDES, *Lemm. in Ber. Deutsch. Bot. Ges.* xviii. (1900) p. 30; *Forschungsber. Biol. Stat. Plön*, xi. (1904) p. 311.

Long. 44–49 μ; lat. 2·5 μ.

Tanganyika.—In plankton, off Niamkolo (2 and 9 Aug. 1904; nos. 36 and 52), in Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 109), near Kasawa (no. 132), near Kassanga (14 Nov. 1904; no. 159), near Maswa (14 Jan. 1905; no. 211), and in middle of lake between Rumonge and Uvira (30 Jan. 1905; no. 218).

203. SYNEDRA CUNNINGTONII, sp. n. (Pl. **8**. fig. 4.)

Cellula ut visa aspectu valvulari angustissima linearis, in parte mediana tertia cum inflationibus insignis latis binis, partibus apicalibus angustissimis cum marginibus parallelis, apicibus minute capitatis, striis 12–13 in 10 μ, in partibus apicalibus elongatis vix conspicuis, pseudorhaphide lata in parte mediana inflata cellulæ; ut visa aspectu cingulato anguste linearis, parte mediana subanguste inflata, polis truncatis.

Long. 200–210 μ; lat. in med. 4·5 μ; lat. max. 6·5 μ; lat. part. apical. 1·4 μ; lat. apic. 1·8 μ.

Victoria Nyanza.—Among *Utricularia*, in sheltered bay near Entebbe (1 May, 1905; no. 620).

This *Synedra* is remarkable for the double inflation of the median part of the valves, the extremities being very long and narrow, with parallel margins. The inflation is not merely visible in the valve-view, but is likewise very large in the girdle-view. In the girdle-view, however, the median inflation has subparallel margins in the central part and does not show any signs of the constriction which is such a peculiar feature of the valve-view. Each of the narrow extremities of the valve is very faintly (almost imperceptibly) swollen.

I know of no species to which it is very closely related except forms of *S. Acus*, and from these it is at once distinguished by its peculiar form.

Family **EUNOTIACEÆ.**

Genus EUNOTIA, *Ehrenb.*

204. Eunotia pectinalis, *Rabenh. Fl. Europ. Alg.* i. (1864) p. 73.—Himantidium pectinale, *Kütz. Bacill.* 1844, t. 16. fig. 11.

Tanganyika.—In swamp, Kituta (26 Aug. 1904 ; no. 80).

Victoria Nyanza.—In swampy pool near Bukoba (20 Apr. 1905 ; no. 618)

205. Eunotia lunaris, *Grun. in Van Heurck, Synops. Diat. Belg.* p. 144, t. 35. figs. 3, 4, 6.—Synedra lunaris, *Ehrenb.* ; *W. Sm. Brit. Diat.* i. p. 69, t. 11. fig. 82.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251), and among *Utricularia*, near Bukoba (20 Apr. 1905 ; no. 618).

206. Eunotia biceps, *Ehrenb.*, 1854.—Synedra biceps, *W. Sm.* Eunotia flexuosa, *Kütz.*, *var.* bicapitata, *Grun. in Van Heurck, Synops. Diat. Belg.* p. 145, t. 35. fig. 11.

Victoria Nyanza.—Among *Utricularia*, near Bukoba (20 Apr. 1905 ; no. 618), and in sheltered bay near Entebbe (1 May, 1905 ; no. 620).

Family **ACHNANTHACEÆ.**

Genus ACHNANTHES, *Bory.*

207. Achnanthes coarctata, *Grun. in Cleve & Grun. Arct. Diat.* p. 20 (1880).

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

208. Achnanthes linearis, (*W. Sm.*) *Grun. l. c.* p. 23.—Achnanthidium lineare, *W. Sm. Brit. Diat.* ii. p. 31, t. 61. fig. 381.

Tanganyika.—In the plankton, Lofu River (5 Oct. 1904 ; no. 123).

Family **COCCONEIDACEÆ.**

Genus COCCONEIS, *Ehrenb.*

209. Cocconeis Placentula, *Ehrenb. Infus.* p. 194 ; *W. Sm. Brit. Diat.* i. p. 21, t. 3. fig. 32.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618). In sheltered bay near Entebbe (1 May, 1905 ; no. 620).

Tanganyika.—On stones, shells, submerged grasses, etc., Niamkolo Bay (Aug. 1904 ; nos. 40 and 44). Among various Algæ, Kituta Bay (26 Aug. 1904 ; no. 79). In plankton, near Mbete (28 Sept. 1904 ; no. 105), Komba Bay (11 Oct. 1904 ; no. 135), off Chamkaluki (15 Nov. 1904 ; no. 160), and near Kala (19 Nov. 1904 ; no. 170). Also among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

210. Cocconeis Pediculus, *Ehrenb. Infus.* p. 11; *W. Sm. Brit. Diat.* i. p. 21, t. 3. fig. 31.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904; no. 36), and Kituta Bay (26 Aug. 1904; no. 81). In shallow water, Mbete (29 Sept. 1904; no. 114).

Family NAVICULACEÆ.

Genus NAVICULA, *Bory.*

211. Navicula (§ Neidium) producta, *W. Sm. Brit. Diat.* i. p. 51, t. 17. fig. 144.—N. Iridis *var.* producta, *Van Heurck, Synops. Diat. Belg.* p. 104, t. 13. fig. 3.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32).

212. Navicula (§ Neidium) Tanganyikæ, sp. n. (Pl. **8**. fig. 11.)

Cellula ut in visa aspectu valvulari oblonga cum lateribus levissime concavis, utroque polis cuneatis et apicibus obtusis; platea axiali angusta, lineis approximatis binis utrobique inter marginem lateralem valvæ unumquemque et axem centrali, platea centrali transverse dilatata (elliptica); punctis valvæ densissimis et irregulariter ordinatis; striis margines versus visis 10–11 in 10 μ.

Long. valv. 76–98 μ; lat. 34–40 μ.

Tanganyika.—In plankton, Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 105), near Kalambo (5 Nov. 1904; no. 154), and near Baraka (24 Feb. 1905; no. 240).

Pfitzer founded the genus *Neidium* in 1871 on the general arrangement of the cell-contents, and Cleve (1894) has pointed out that the structure of the valve is also sufficient to separate the species included in *Neidium* from the rest of the naviculoid Diatoms. *N. Tanganyikæ* is on the whole nearest to *N. Amphigomphus*, Ehrenb., but in none of the specimens I examined were the punctæ of the valves arranged in lines. There were a pair of accessory longitudinal lines, closely approximate, and running from pole to pole between the central line and each margin of the valve. These lines were situated rather nearer the outer margin than the median line, and they were regularly bent inwards in the cuneate poles. The central area was transversely elliptical and the punctæ were rather more distinct in its immediate vicinity. The striations could only be observed between the margins of the valve and the accessory longitudinal lines. The area between the latter and the sagittal axis (or raphe) was entirely occupied by irregularly scattered punctæ.

213. Navicula (§ Diploneis) elliptica, *Kütz. Bacill.* (1844) p. 98, t. 30. fig. 55.—N. ovalis, *W. Sm. Brit. Diat.* i. p. 48, t. 18. fig. 153 *a'*?

Nyasa.—In plankton, Anchorage Bay (13 June, 1904; no. 9).

Tanganyika.—In plankton, near Sumbu (13 Oct. 1904 ; no. 138) and near Kalambo (5 Nov. 1904 ; no. 154). Among various Algæ scraped from the inside of canoe (6 Jan. 1905 ; no. 205).

214. NAVICULA PUPULA, *Kütz. Bacill.* (1844) p. 93 ; *Van Heurck, Synops. Diat. Belg.* p. 106, t. 13. figs. 15, 16 ; *Cleve, Synops. Navic. Diat.* i. (1894) p. 131.

Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904 ; no. 81), near Kalambo (5 Nov. 1904 ; no. 154), near Kala (19 Nov. 1904 ; no. 170), off Kirando (1 Dec. 1904 ; no. 175), and near Baraka (24 Feb. 1905 ; no. 240).

215. NAVICULA MUTICA, *Kütz. l. c.* t. 3. fig. 32 ; *Cleve, Synops. Navic. Diat.* i. (1894) p. 129.

Forma valvis leviter tumidis ad medium utrobique.

Long. valv. 30–34 μ ; lat. ad med. 13–14 μ.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904 ; nos. 9 and 10).

216. NAVICULA CRUCICULA, (*W. Sm.*) *Donkin, Brit. Diatomaceæ*, p. 44, t. 6. fig. 14 ; *Cleve, Synops. Navic. Diat.* i. (1894) p. 139.—Stauroneis Crucicula, *W. Sm.*

Nyasa.—In plankton, Anchorage Bay (11 June, 1904 ; no. 5).

217. NAVICULA BAHUSIENSIS, *Grun. Diat. Franz-Jos.-land*, p. 51 (1880) ; *Cleve, Synops. Navic. Diat.* ii. (1895) p. 4.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904 ; no. 9).

Tanganyika.—In plankton, off Kirando (1 Dec. 1904 ; no. 175).

This Diatom has previously been recorded only as a marine species, but is regarded by Van Heurck as a variety of *N. minuscula*, Grun., which is of freshwater habit.

218. NAVICULA (§ ANOMŒONEIS) SPHÆROPHORA, *Kütz. Bacill.* 1844, p. 95, t. 4. fig. 17.

Nyasa.—On shores of lake, Domira Bay (19 June, 1904 ; no. 17).

219. NAVICULA (§ ANOMŒONEIS) EXILIS, *Kütz. l. c.* ; *Van Heurck, Synops. Diat. Belg.* p. 101, t. 12. figs. 11, 12.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

220. NAVICULA CRYPTOCEPHALA, *Kütz. l. c.* t. 3. fig. 26 ; *W. Sm. Brit. Diat.* p. 53, t. 17. fig. 155.

Tanganyika.—In swamp, Toa (10 Jan. 1905 ; no. 208).

221. NAVICULA RADIOSA, *Kütz. t. c.* p. 91, t. 4. fig. 23.

Victoria Nyanza.—In plankton, near Bukoba (18 Apr. 1905 ; no. 249).

Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904; no. 81), and off Kirando (1 Dec. 1904; no. 175).

222. NAVICULA RHYNCHOCEPHALA, *Kütz. Bacill.* (1844) t. 30. fig. 35; *Donkin, Brit. Diat.* p. 38, t. 6. fig. 4.

Nyasa.—In plankton, Anchorage Bay (June 1904; nos. 9 and 10).

Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904; no. 81), near Mbete (28 Sept. 1904; no. 105), and near Chamkaluki (15 Nov. 1904; no. 160). In swamp, Toa (10 Jan. 1905; no. 208).

223. NAVICULA DISTINCTA, sp. n.

Minuta; cellula ut in visa aspectu valvulari late elliptica, polis rotundatis vel subacute rotundatis; striis validis, distinctis et glabris, 8 in 10 μ, radiatis, in parte mediana striis brevibus 2 vel 3 cum striis multe longioribus alternantibus.

Long. 20–24 μ; lat. 16–17 μ.

Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170.)

This small species is distinct by reason of its broadly elliptical valves and the conspicuous striations. There are in all 17 or 18 striations along each side of the valve, markedly radiating in disposition, and reaching close up to the sagittal line or raphe. Two or three of the median striations are relatively short, extending only about halfway from the margin of the valve to the sagittal line. These short striations do not occur next each other, but alternate with those of maximum length. The striations appear to be perfectly smooth.

224. NAVICULA GASTRUM, *Kütz. Bacill.* (1844) p. 94; *Donkin, Brit. Diat.* p. 22, t. 3. fig. 10; *Van Heurck, Synops. Diat. Belg.* p. 87, t. 8. figs. 25, 27.

Nyasa.—In plankton, Anchorage Bay (June 1904; nos. 9 and 10). On rocks, Deep Bay (25 June, 1904; no. 26).

Tanganyika.—In plankton, Kitutu Bay (26 Aug. 1904; no. 81), near Niamkolo (7 Sept. 1904; no. 88), near Mbete (28 Sept. 1904; no. 105), Lofu (6 Oct. 1904; no. 130), near Kala (19 Nov. 1904; no. 170), and near Kirando (1 Dec. 1904; no. 175).

From no. 175 some very large forms were observed: length 64 μ; lat. 28 μ.

225. NAVICULA DICEPHALA, *W. Sm. Brit. Diat.* i. p. 87, t. 17. fig. 157.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

Tanganyika.—In rain-water pool on large rock near the shore, Utinta (6 Dec. 1904; no. 186).

226. NAVICULA (§ PINNULARIA) INTERRUPTA, *W. Sm. l. c.* ii. p. 96; *Cleve, Synops. Navic. Diat.* ii. (1895) p. 76.—N. bicapitata, *Lagerst.* Pinnularia biceps, *Greg.*

The specimens observed had a rhomboidal central area (=forma *biceps*): long. 60 μ; lat. ad med. 13 μ; lat. apic. 8·5 μ.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

227. NAVICULA (§ PINNULARIA) MESOLEPTA, *Ehrenb.*; *Kütz. Bacill.* p. 101 (1844); *W. Sm. Brit. Diat.* t. 19. fig. 182; *Van Heurck, Synops. Diat. Belg.* p. 79, t. 6. figs. 10, 11.

Tanganyika.—In swamp, Toa (10 Jan. 1905; no. 208).

228. NAVICULA (§ PINNULARIA) GIBBA, (*Ehrenb.*) *W. Sm. Brit. Diat.* i. t. 19. fig. 180.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22). In swamp, Kambwelagoon near Karonga (27 June, 1904; no. 20).

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904; nos. 195 and 196). In swamp, Toa (10 Jan. 1905; no. 208).

229. NAVICULA (§ PINNULARIA) ACROSPHÆRIA, (*Bréb.*) *Kütz. Bacill.* (1844) p. 97, t. 5. fig. 2; *W. Sm. Brit. Diat.* t. 19. fig. 183.

Nyasa.—In swamp, Karonga (29 June, 1904; no. 32, and 2 July, 1904; no. 33).

230. NAVICULA (§ PINNULARIA) DACTYLUS, *Ehrenb.*, *ex Van Heurck, Synops. Diat. Belg.* t. 5. fig. 1.

Tanganyika.—In swamp, Kituta (26 Aug. 1904; no. 80).

231. NAVICULA (§ PINNULARIA) VIRIDIS, *Kütz. l. c.* t. 30. fig. 12; *Van Heurck, l. c.* t. 5. fig. 5.

Victoria Nyanza.—In swampy pools, near Bukoba (20 Apr. 1905; no. 251).

232. NAVICULA (§ PINNULARIA) CARDINALIS, *Ehrenb. in Abh.* p. 19 (1840); *W. Sm. Brit. Diat.* i. t. 19. fig. 166.

Victoria Nyanza.—With the preceding species, but not so abundant (no. 251).

Genus STAURONEIS, *Ehrenb.*

233. STAURONEIS ANCEPS, *Ehrenb. in Phys. Abh. Akad. Wiss. Berl.* 1841 (1843), p. 422; *Cleve, Synops. Navic. Diat.* i. (1894) p. 147.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Victoria Nyanza.—In swampy pools, near Bukoba (20 Apr. 1905; no. 251).

Genus SCHIZOSTAURON, *Grun.*

234. SCHIZOSTAURON CRUCICULA, *Grun. in Cleve, New or little-known Diat.* p. 16 (1881).—Stauroneis Crucicula, *Cleve, Synops. Navic. Diat.* i. (1894) p. 151.

Large forms : long. 42–65 μ ; lat. 9·5–15·5 μ ; lat. apic. 3·2–3·8 μ. Valves oblong or oblong-lanceolate, with rostrate apices. (Pl. **8.** fig. 12.)

Tanganyika.—Plankton, Kituta Bay (26 Aug. 1904 ; no. 81), Komba Bay (11 Oct. 1904 ; no. 135), and near Kirando (1 Dec. 1904 ; no. 175).

The bifid stauros and the longitudinal septa (or diaphragms) in the apical parts of the valves are the distinguishing features between this genus and *Stauroneis*. The specimens observed were all obtained from the fine surface plankton, and they reached almost twice the size of any previously recorded examples. The striæ were very fine, about 23 or 25 in 10 μ.

Genus VANHEURCKIA, *Bréb.*

235. VANHEURCKIA RHOMBOIDES, (*Ehrenb.*) *Bréb. Monogr.* p. 4 (1869) ; *Van Heurck, Synops. Diat. Belg.* p. 112, t. 17. figs. 1, 2.—Navicula rhomboides, *Ehrenb.* ; *W. Sm. Brit. Diat.* i. p. 46, t. 16. fig. 129. Frustulia rhomboides, *De Toni.*

Victoria Nyanza.—In swampy pools, near Bukoba (20 Apr. 1905 ; no. 251).

Var. SAXONICA, (*Rabenh.*) *G. S. West.*—Frustulia saxonica, *Rabenh.* Navicula crassinervia, *Bréb. in W. Sm. Brit. Diat.* i. p. 47, t. 31. fig. 271.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

Victoria Nyanza.—In swampy pool, near Bukoba (20 Apr. 1905 ; no. 618).

236. VANHEURCKIA VULGARIS, (*Thw.*) *Van Heurck, Synops. Diat. Belg.* p. 112, t. 17. fig. 6.—Colletonema vulgaris, *Thw.*

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 123).

Genus GYROSIGMA, *Hass.*

237. GYROSIGMA ATTENUATUM, (*Kütz.*) *Cleve, Synops. Navic. Diat.* i. (1894) p. 114.—Pleurosigma attenuatum, *W. Sm. Brit. Diat.* i. p. 68, t. 22. fig. 216.

Tanganyika.—In plankton, near Kassanga (14 Nov. 1904 ; no. 159), near Kala (19 Nov. 1904 ; no. 170), near Maswa (14 Jan. 1905 ; no. 211), and near Baraka (24 Feb. 1905 ; no. 240).

The specimens observed were all considerably shorter than is usual in this species. The apices of the valves were not quite so attenuated as in European examples.

238. GYROSIGMA NODIFERUM, (*Grun.*).—Pleurosigma nodiferum, *Grun. Arct. Diat.* p. 59. P. Spenceri, *W. Sm., var.* nodifera, *Van Heurck, Synops. Diat. Belg.* (1885) p. 118, t. 21. fig. 13 ; *Cleve, Synops. Navic. Diat.* i. (1894) p. 117.

Long. 152 μ ; lat. 17 μ.

Tanganyika.—In plankton, near Kala (19 Nov. 1904 ; no. 170).

The general form of this species and the curious elongated, *oblique* central nodule appear to me to be quite distinctive.

Family GOMPHONEMACEÆ.

Genus GOMPHONEMA, *Ag.*

239. Gomphonema parvulum, *Kütz. Bacill.* p. 83 (1844) ; *Van Heurck, Synops. Desm. Belg.* p. 125, t. 25. fig. 9.

Nyasa.—On bivalve shells, Anchorage Bay (no. 11). On rocks, Deep Bay (25 June, 1904 ; no. 26).

Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904 ; no. 114). In plankton, Lofu River (5 Oct. 1904 ; no. 123). Among Algæ scraped from the bottom of Dr. Cunnington's dau (24 Jan. 1905 ; nos. 216 and 217).

Var. micropus, (*Kütz.*) *Cleve, Synops. Navic. Diat.* i. (1894) p. 180.—G. micropus, *Kütz. Bacill.* (1844) p. 84.

Victoria Nyanza.—On rocks, near Bukoba (17 Apr. 1905 ; no. 247).

240. Gomphonema angustatum, *Kütz. l. c.* p. 83 ; *Cleve, l. c.* p. 181.

Nyasa.—On stones, shores of Domira Bay (19 June, 1904 ; no. 17).

241. Gomphonema intricatum, *Kütz. l. c.* p. 87, t. 9. fig. 4.

Nyasa.—On *Cladophora*, Anchorage Bay (no. 11). On rocks and in shore-pools, Nkata Bay (23 June, 1904 ; nos. 22 and 23).

Var. Vibrio, (*Ehrenb.*) *Van Heurck* ; *Cleve, l. c.* p. 182.—G. Vibrio, *Ehrenb.*

Nyasa.—On stones, shores of Domira Bay (19 June, 1904 ; no. 17). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

242. Gomphonema gracile, *Ehrenb. Infus.* p. 217 (1838) ; *Cleve, l. c.* p. 185.

Nyasa.—In swamp, Karonga (29 June, 1904 ; no. 32).

Victoria Nyanza.—On rocks, near Bukoba (17 Apr. 1905 ; no. 247).

Var. dichotomum, (*W. Sm.*) *Van Heurck.*—G. dichotomum, *W. Sm. Brit. Diat.* i. p. 79, t. 28. fig. 240.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

243. Gomphonema exiguum, *Kütz. l. c.* p. 84, t. 30. fig. 58 ; *Cleve, Synops. Navic. Diat.* i. (1894) p. 188.

Victoria Nyanza.—On Algæ attached to rocks, near Bukoba (17 Apr. 1905 ; no. 247).

Tanganyika.—In large numbers attached to decaying fragments of *Cladophora* sp., in plankton off Niamkolo Island (29 June, 1904 ; no. 36). On Algæ floating in Kituta Bay (26 Aug. 1904 ; no. 79). Attached to Algæ scraped from bottom of Dr. Cunnington's dau (24 Jan. 1905 ; no. 217).

This species appears to have been previously recorded only as marine in habit.

244. Gomphonema africanum, sp. n. (Pl. **8**. fig. 13.)

G. magna ; cellula ut in visa aspectu valvulari ovato-lanceolata, lateribus inferioribus leviter concavis, lateribus superioribus convexis, apice subacuto, ad basin angulari-rotundata, cum stigmati singulo unilaterali prope nodulum centralem, platea axiali angusta in medio non dilatata, striis 10–11 in 10 μ, transversis sed radiatis prope apicem ; in visa aspectu cingulato cuneata, basi et apice rotundato-truncato, lateribus levissime biundulato.

Long. 102–128 μ ; lat. max. 23–28 μ ; lat. apic. aspect. cingul. usque ad 34 μ.

Tanganyika.—Among *Chætomorpha Linum*, Kütz., floating on surface of Kituta Bay (26 Aug. 1904 ; no. 79). On rocks, in shallow water, near Mbete (29 Sept. 1904 ; no. 114).

This species should be compared with *G. oxycephalum*, Cleve, Synops. Navic. Diat. i. (1894) p. 187, t. 5. fig. 10.

Family **COCCONEMACEÆ.**

Genus COCCONEMA, *Ehrenb.*

245. Cocconema læve, (*Näg.*) *nob.*—Cymbella lævis, *Näg. in Kütz. Sp. Alg.* (1849) p. 59 ; *Van Heurck, Synops. Diat. Belg.* p. 62, t. 3. fig. 7.

Tanganyika.—In plankton, Lofu River (5 Nov. 1904 ; no. 124).

246. Cocconema leptoceros, *Ehrenb. in Phys. Abh. Akad. Wiss. Berl.* 1841 (1843), p. 412.—Cymbella leptoceros, *Rabenh. Süssw. Diat.* t. 7. fig. 14 (1843) ; *Van Heurck, l. c.* p. 62, t. 2. fig. 18.

Victoria Nyanza.—Near Bukoba (17 Apr. 1905 ; no. 248).

247. Cocconema grossestriatum, (*O. Müll.*) *nob.*—Cymbella grossestriata, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 154, t. 1. fig. 13.

Var. Tanganyikæ, var. n. (Pl. **8**. fig. 9.)

Var. margine ventrali convexiore, polis obtusioribus sed levissime productis ; striis validis et latis, 3·5 in 10 μ (ad pol. 4 in 10 μ).

Long. 74 μ ; lat. 29 μ.

Tanganyika.—In plankton, near Kassanga (14 Nov. 1904; no. 159) and near Kirando (1 Dec. 1904 ; no. 175).

This is a handsome Diatom with exceedingly coarse striæ composed of large granules. The specimens observed from Tanganyika were stouter and more swollen on the ventral margin than Müller's Nyasa specimens, the striæ being even coarser.

248. Cocconema turgidum, (*Greg.*) *nob.*—Cymbella turgida, *Greg.* (1856); *Cleve, Synops. Navic. Diat.* i. (1894) p. 168.

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18).

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904 ; no. 196).

249. COCCONEMA VENTRICOSUM, (*Kütz.*) *nob.*—Frustulia ventricosa, *Kütz.* (1834). Encyonema ventricosum, *Van Heurck.* E. cæspitosum, *Kütz.* (1849).

Tanganyika.—On the shore, near Niamkolo (1 Aug. 1904 ; no. 44) and in Niamkolo Harbour (7 Sept. 1904 ; no. 87).

250. COCCONEMA GRACILE, (*Rabenh.*) *G. S. West, Treat. Brit. Freshw. Alg.* (1904) p. 299.—Encyonema gracile, *Rabenh.*

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18).

Victoria Nyanza.—In swampy pool, near Bukoba (20 Apr. 1904 ; no. 618).

Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 123).

251. COCCONEMA CYMBIFORME, *Ehrenb. Infus.* p. 225 (1838) ; *W. Sm. Brit. Diat.* i. p. 76, t. 23. fig. 220.

Nyasa.—In plankton, Deep Bay (24 June, 1904 ; no. 25). Among Algæ on rocks, Deep Bay (25 June, 1904 ; no. 26). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Victoria Nyanza.—Swampy pool, near Bukoba (20 Apr. 1905 ; no. 618). In sheltered bay, near Entebbe (1 May, 1905 ; no. 620) ; very numerous and with sporangial valves.

Tanganyika.—In plankton, near Mbete (21 Sept. 1904 ; no. 105) and in Vua Harbour (29 Oct. 1904 ; no. 150). In swampy pond, Mrumbi (27 Dec. 1905 ; no. 195). Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

252. COCCONEMA CISTULA, (*Ehrenb.*) *W. Sm. Brit. Diat.* i. p. 76, t. 23. fig. 221.

Tanganyika.—Komba Bay (10 Oct. 1904 ; no. 134). Among Algæ scraped from bottom of Dr. Cunnington's dau (24 Jan. 1905 ; no. 217).

Var. MACULATUM, (*Kütz.*) *Cleve, Synops. Navic. Diat.* i. (1894) p. 173.—Cymbella maculata, *A. Schm. Atlas,* t. 71. fig. 21.

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).

Genus AMPHORA, *Ehrenb.*

253. AMPHORA OVALIS, *Kütz. Synops, Diat.* (1833) ; *Bacill.* (1844) p. 107, t. 5. figs. 35, 39 ; *Rabenh. Fl. Europ. Alg.* i. (1864) p. 91.

Nyasa.—On shore, Domira Bay (19 June, 1904 ; no. 17). In swamp, Karonga (July, 1904 ; nos. 33 and 34).

Tanganyika.—In plankton, Mbete (28 Sept. 1904 ; no. 105), Komba Bay (11 Oct. 1904 ; no. 135), near Kala (19 Nov. 1904 ; no. 170), off Kirando (1 Dec. 1904 ; no. 175), and near Baraka (24 Feb. 1905 ; no. 240).

254. AMPHORA COFFÆIFORMIS, (*Ag.*) *Kütz. Bacill.* (1844) p. 108 ; *Cleve, Synops. Navic. Diat.* ii. (1895) p. 120.

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904 ; no. 135).

Genus EPITHEMIA, *Bréb.*

255. Epithemia turgida, (*Ehrenb.*) *Kütz. Bacill.* (1844) p. 34, t. 5. fig. 14; *Rabenh. Fl. Europ. Alg.* i. (1864) p. 62.

Nyasa.—In plankton, Anchorage Bay (June 1904; nos. 9 and 10). In swamp, Karonga (29 June, 1904; no. 32). Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

Tanganyika.—In plankton, near Mbete (28 Sept. 1904; no. 105) and near Kala (19 Nov. 1904; no. 170). Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905; no. 611).

Genus RHOPALODIA, *O. Müll.*

256. Rhopalodia gibba, (*Kütz.*) *O. Müll. in Engl. Bot. Jahrb.* xxii. (1895) p. 65.—Epithemia gibba, *Kütz. Bacill.* (1844) p. 35, t. 4. fig. 22; *W. Sm. Brit. Diat.* p. 15, t. 1. fig. 13.

Tanganyika.—In swampy pond, Mrumbi (27 Dec. 1904; no. 181).

Var. ventricosa, (*Kütz.*) *O. Müll.*—Epithemia ventricosa, *Kütz.*

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904; no. 579).

Victoria Nyanza.—In plankton, near Bukoba (21 June, 1905; no. 252). In sheltered bay, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, Kituta Bay (27 Aug. 1904; no. 82) and near Sumbu (13 Oct. 1904; no. 138).

257. Rhopalodia gibberula, (*Ehrenb.*) *O. Müll. l. c.* xxxvi. (1905) p. 165. —Epithemia gibberula, *Kütz. Bacill.* (1844) t. 30. fig. 3.

Nyasa.—Among Algæ in shallow water, Anchorage Bay (15 June, 1904; no. 12). On rocks, Nkata Bay (23 June, 1904; no. 23). In swamp, Karonga (2 July, 1904; no. 33).

Tanganyika.—Among floating Algæ, Kituta Bay (26 Aug. 1904; no. 79).

258. Rhopalodia hirudiniformis, *O. Müll. l. c.* p. 167.

Nyasa.—In the plankton, Anchorage Bay (14 June, 1904; no. 10). In swamp, Kota Kota (20 June, 1904; no. 18). On rocks, Deep Bay (25 June, 1904; no. 26). In swamp, Karonga (29 June, 1904; no. 32). In scrapings from off bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904; no. 577).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252). In swampy pool, near Bukoba (20 Apr. 1905; no. 618). Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton off Niamkolo Island (29 July, 1904; no. 36). Floating in Kituta Bay (26 Aug. 1904; no. 79). On rocks, Mbete (29 Sept. 1904; no. 114). In plankton, near Kala (19 Nov. 1904; no. 170).

259. Rhopalodia gracilis, *O. Müll. in Engl. Bot. Jahrb.* xxii. (1895) p. 63 ; *A. Schm. Atlas Diat.* t. 255. figs. 22–27.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36) and off Kalambo (5 Nov. 1904 ; no. 154).

Var. undulata, *O. Müll. in Hedwigia*, xxxvi. (1905) p. 163, t. 1. fig. 17.

Nyasa.—In plankton, Anchorage Bay (no. 1) and off Vahambwera Point (24 June, 1904 ; no. 24).

Var. impressa, *O. Müll.* ; *A. Schm. Atlas Diat.* t. 255. figs. 28–32.

Nyasa.—Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

260. Rhopalodia vermicularis, *O. Müll. l. c.* p. 67, t. 1. figs. 34–39, t. 2. figs. 10, 11, 14 ; *A. Schm. Atlas Diat.* t. 256. figs. 17–19.

Nyasa.—In plankton, Monkey Bay (17 June, 1904 ; no. 14). On rocks, Deep Bay (25 June, 1904 ; no. 26).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620). This species is commonly attached by thick gelatinous stalks and occurs in dense clusters. It was observed forming thick, yellow-brown, matted masses on the back of a beetle (*Limnogeton*) on the lake shore, Karonga, Nyasa.

Family NITZSCHIACEÆ.

Genus NITZSCHIA, *Hass.* ; *em. Grunow.*

261. Nitzschia Tryblionella, *Hantzsch, in Rabenh. Alg.* no. 980 (1860).

Var. littoralis, (*Grun.*) *Van Heurck.*—N. littoralis, *Grun.*

Tanganyika.— In plankton, near Niamkolo (7 Sept. 1904 ; no. 88).

262. Nitzschia Lancettula, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 175, t. 2. fig. 15.

Long. 46–48 μ ; lat. 10–11 μ ; punct. carin. 6 in 10 μ ; striis 13 in 10 μ.

Nyasa.—In plankton, Anchorage Bay (June 1904 ; nos. 9 and 10).

263. Nitzschia dissipata, (*Kütz.*) *Grun. in Cleve & Grun. Arct. Diat.* p. 90 (1880).—Synedra dissipata, *Kütz.*

Var. media, *Hantzsch.*

Tanganyika.—In plankton, near Sumbu (13 Oct. 1904 ; no. 138).

264. Nitzschia tubicola, *Grun. l. c.* p. 97 ; *Van Heurck, Synops. Diat. Belg.* (1885) t. 69. fig. 14.

Long. 69 μ ; lat. 7 μ ; punct. carin. 7 in 10 μ.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36) and near Kala (19 Nov. 1904 ; no. 170).

265. NITZSCHIA AMPHIBIA, *Grun. in Wien. Verhandl.* (1882) p. 574 ; *Van Heurck, Synops. Diat. Belg.* (1885) p. 184, t. 68. figs. 15–17.

Cellulæ lanceolatæ cum punct. carin. 7 in 10 μ ; long. 35 μ ; lat. 10 μ.

Nyasa.—Abundant in scrapings off bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 ; no. 577).

266. NITZSCHIA LINEARIS, *W. Sm. Brit. Diat.* i. p. 39, t. 13. fig. 110.

Var. TENUIS, *Grun.*—N. tenuis, *W. Sm.*

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18).

Tanganyika.—In swamp, Mrumbi (27 Dec. 1904 ; no. 196).

267. NITZSCHIA PALEA, (*Kütz.*) *W. Sm. l. c.* ii. p. 89.—Synedra Palea, *Kütz. Bacill.* (1844) t. 3. fig. 27, t. 4. fig. 2.

Nyasa.—In swamp, Kota Kota (20 June, 1904 ; no. 18). On rocks, Nkata Bay (24 June, 1904 ; no. 23). In swamp, Karonga (2 July, 1904 ; no. 34).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).

Tanganyika.—On rocks, Niamkolo Harbour (7 Sept. 1904 ; no. 87). In plankton, near Mbete (28 Sept. 1904 ; no. 108). In swamp, Toa (10 Jan. 1905 ; no. 208).

Var. DEBILIS, *Van Heurck.*

Victoria Nyanza.—On rocks, Bukoba (17 Apr. 1905 ; no. 248).

Var. TENUIROSTRIS, *Van Heurck.*

Tanganyika.—In swamp, Toa (10 Jan. 1905 ; no. 208).

268. NITZSCHIA NYASSENSIS, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 177, t. 2. figs. 5–9.

Long. 380–430 μ ; lat. ad med. (aspect. valv.) 3·2 μ. (Pl. **4**. figs. 7–9.)

Nyasa.—In plankton, off Vahambwera Point (24 June, 1904 ; no. 24) and off Karonga (1 July, 1904 ; no. 30). Also in swamp, Kambwelagoon near Karonga (27 June, 1904 ; no. 29).

Tanganyika.—In plankton, Niamkolo (July and Aug. 1904 ; nos. 36, 39, and 52), Kituta Bay (Aug. 1904 ; nos. 77 and 81), near Mbete (28 Sept. 1904 ; nos. 105 and 109), Komba Bay (11 Oct. 1904 ; no. 135), Vua Harbour (29 Oct. 1904 ; no. 150), near Kalambo (5 Nov. 1904 ; no. 154), near Kirando (1 Dec. 1904 ; no. 175), Utinta (5 Dec. 1904 ; no. 181), and near Maswa (14 Jan. 1905 ; no. 211). Also in Mtondwe Bay, among Algæ scraped from shells (2 Sept. 1904 ; no. 83).

This Diatom occurred in prodigious quantity in the plankton of Tanganyika, more especially from July to September. I am somewhat doubtful regarding its exact identification, as it seems to me to resemble so closely the slender and elongated species of *Synedra*. It undoubtedly agrees with Müller's

species, which he described from the plankton of Nyasa and the pools in the vicinity of that lake, but I am not convinced of its correct inclusion in the genus *Nitzschia*. On first examining it I took it to be a form of *Synedra Lemmermannii*, W. & G. S. West ("Plankton of Some Irish Lakes," Trans. Roy. Irish Acad. xxxiii. (1906) p. 109, t. 11. figs. 1, 2), but the frustules are not so straight as in that species, the markings not so distinct, and the poles much less capitate. The African forms were commonly a little curved, which is not surprising in such a long narrow Diatom, and in some of the collections they were often curiously bent (especially in nos. 52 and 150). In this species, and very probably in several other shorter ones, the genera *Nitzschia* and *Synedra* merge into each other.

Family **SURIRELLACEÆ.**

Genus SURIRELLA, *Turp.*

269. Surirella robusta, *Ehrenb. in Ber. Akad. Berl.* (1840) p. 215.—S. nobilis, *W. Sm. Brit. Diat.* i. p. 32, t. 7. fig. 63.

Var. splendida, (*Ehrenb.*) *Van Heurck, Synops. Diat. Belg.* 1885, p. 187, t. 72. fig. 4.—S. splendida, *Kütz. Bacill.* (1844) p. 62, t. 7. fig. 9.
Tanganyika.—In plankton, Lofu River (5 Oct. 1904 ; no. 124).

270. Surirella Fülleborni, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 30, t. 1. fig. 11.
Victoria Nyanza.—In plankton, near Bukoba (18 Apr. 1905 ; no. 249).

Var. elliptica, *O. Müll. l. c.* p. 31, t. 1. fig. 13.
Long. 216–250 μ ; lat. 80–97 μ. (Pl. **3.** figs. 3, 4.)
Victoria Nyanza.—With the typical form, but much more abundant (nos. 249 and 252).

271. Surirella bifrons, (*Ehrenb.*) *Kütz. Bacill.* (1844) p. 61.

Var. tumida, *O. Müll. l. c.* p. 27, t. 1. fig. 2.
Long. 98–160 μ ; lat. 46–53 μ.
Nyasa.—In plankton, Anchorage Bay (June, 1904 ; nos. 9 and 10).
Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905 ; no. 249).

Var. intermedia, *O. Müll. l. c.* p. 27, t. 1. fig. 1.
Nyasa.—In plankton, Anchorage Bay (June, 1904 ; nos. 9 and 10).

272. Surirella Malombæ, *O. Müll. l. c.* p. 34, t. 2. fig. 5 [*inclus. forma* acuta, *O. Müll. l. c.* t. 2. fig. 7].
Long. 125–161 μ ; lat. 70–74 μ. (Pl. **3.** figs. 2, 13, 14, 22, 23.)
Victoria Nyanza.—Very abundant in the plankton, near Bukoba (Apr. 1905; nos. 249 and 252).

This species was in great abundance and every intermediate stage was noticed between it and *S. bifrons* var. *tumida*. Many of the forms of *S. bifrons* var. *tumida* from Lake Nyasa might have been equally well named *S. Malombæ*. Much variation was also shown in the apiculation of the extremities.

273. SURIRELLA NYASSÆ, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 33, t. 2. fig. 3 [*inclus. var.* Sagitta, *O. Müll. l. c.* t. 2. fig. 4].

Long. 359–382 μ ; lat. max. 69–75 μ ; lat. ad med. 54–57 μ.

Nyasa.—In plankton, off Vahambwera Point (24 June, 1904 ; no. 24), Deep Bay (24 June, 1904 ; no. 25), and off Karonga (1 July, 1904 ; no. 30).

This handsome species was very abundant and many intermediate states occurred between the typical form as described by Müller and his var. *Sagitta*. It is a large species, which, so far as present observations go, appears to be confined to the plankton of Lake Nyasa.

Many of the frustules were thickly coated with attached *Vorticellæ* (*vide* Pl. **2**. figs. 11, 12).

274. SURIRELLA PLANA, sp. n. (Pl. **8**. fig. 5.)

S. subparva ; cellula ut in visa aspectu valvulari ovato-elliptica ; pseudorhaphide recta et distincta ; costis validis subconfertis, circiter 3 in 10 μ (29–30 in margine laterali unoquoque), transversis sed polos versus leviter radiatis, pseudorhaphidem extensis ; alis curtis juxta margines laterales.

Long. 103 μ ; lat. max. 39 μ.

Tanganyika.—In plankton, near Ndauvie (7 Feb. 1905 ; no. 227).

This Diatom was only noticed from one of the plankton collections. It should be compared with *S. diaphana*, Bleisch, and *S. tenera*, Greg.

275. SURIRELLA LINEARIS, *W. Sm. Brit. Diat.* i. p. 31, fig. 58 *a*.

Victoria Nyanza.—Among *Utricularia*, near Bukoba (20 Apr. 1905 ; no. 618).

276. SURIRELLA CONSTRICTA, *Ehrenb. Mikr.* t. 14. fig. 37 (1854).—Navicula ? constricta, *Ehrenb. Infus.* 1838, p. 188, t. 21. fig. 17.

Var. AFRICANA, *O. Müll. in Engl. Bot. Jahrb.* xxxvi. (1905) p. 32, t. 2. fig. 1.

Long. 250–295 μ ; lat. max. 42–45 μ ; lat. min. 33–34 μ.

Tanganyika.—In plankton, Niamkolo (7 Sept. 1904 ; no. 88), near Sumbu (13 Oct. 1904 ; no. 138), and near Kassanga (14 Nov. 1904 ; no. 159).

277. SURIRELLA OBTUSIUSCULA, sp. n. (Pl. **8**. fig. 7.)

S. parva ; cellula ut in visa aspectu valvulari oblongo-elliptica, marginibus lateralibus leviter concavis (cellula levissime et gradatim constricta), polis obtusis ; pseudorhaphide recta vix distincta ; costis brevibus, transversis sed polos versus radiatis, 4 in 10 μ (20–21 in margine laterali unoquoque) ; alis ad margines laterales ; cellula ut in visa aspectu cingulato oblonga, marginibus lateralibus in medio retusis, polis truncatis sed angulis rotundatis.

Long. 60–62 μ; lat. max. 18 μ; lat. min. 16 μ.

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135) and near Kala (19 Nov. 1904; no. 170).

Compare with *S. linearis*, W. Sm., and *S. constricta*, Ehrenb.

278. SURIRELLA TANGANYIKÆ, sp. n. (Pl. **8.** fig. 6.)

S. parva; cellula ut in visa aspectu valvulari elliptico-oblonga, marginibus lateralibus in parte mediana subparallelis, polis subconicis ad extremo leviter rotundatis; pseudorhaphide recta et distincta; costis validis paucis 2–2½ in 10 μ (12–13 in margine laterali unoquoque), subbrevibus, iis in medio transversis, iis ad polos radiatis; alis intra et juxta margines laterales; valvis inter costos dense et valde punctata; cellula ut in visa aspectu cingulato oblongo-rectangularis, angulis rotundatis.

Long. 84–88 μ; lat. 30–32 μ.

Tanganyika.—In plankton, Kituta Bay (25 Aug. 1904; no. 77), near Mbete (28 Sept. 1904; no. 105), and near Kala (19 Nov. 1904; no. 170).

This species was not uncommon in the above plankton collections. The costæ are relatively few, although occasionally slightly irregular in their arrangement; and they are also short, only extending about half the distance from the margin of the valve to the sagittal axis (pseudoraphe). The alæ as seen in the valve-view are marginal or just within the margin. The entire valve between the costæ and right up to the pseudoraphe is strongly punctate. There is no hyaline area on each side of the pseudoraphe.

The outward form of the valve, the few and remote costæ, and the strong punctulations are features which separate *S. Tanganyikæ* from any other species.

279. SURIRELLA STRIATULA, *Turp. in Dict. Sc. Nat.* li. p. 508 (Suriraya); *Kütz. Bacill.* (1844) p. 62, t. 7. fig. 6; *Schmidt, Atlas Diat.* t. 24. figs. 17 & 20.

Long. 120 μ; lat. 82 μ.

Tanganyika.—In plankton, near Maswa (14 Jan. 1905; no. 211) and near Baraka (24 Feb. 1905; no. 240).

This interesting species is mostly marine and submarine in habit.

Genus CYMATOPLEURA, *W. Sm.*

280. CYMATOPLEURA SOLEA, *W. Sm. in Ann. Mag. Nat. Hist.* ser. 2, vii. (1851) p. 12; *Brit. Diat.* i. p. 36, t. 10. fig. 78.—Surirella Solea, *Kütz. Bacill.* (1844) p. 60, t. 3. fig. 61.

Nyasa.—In plankton, Anchorage Bay (13 June, 1004; no. 9) and off Karongo (1 July, 1904; no. 30).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, Kituta Bay (26 Aug. 1904; no. 81), Komba Bay (11 Oct. 1904; no. 135), near Kirando (1 Dec. 1904; no. 175), and near Ndauvie (7 Feb. 1905; no. 227).

Forma cellulis curtis, polis mucronatis, ad formam *apiculatam* (= *C. apiculata*, W. Sm.) accedens.

Tanganyika.—In plankton, near Kala (19 Nov. 1904 ; no. 170).

Var. LATICEPS, *O. Müll. in Engl. Bot. Jahrb.* xxxiv. (1905) p. 22 cum fig. 2.

Nyasa.—In plankton, Anchorage Bay (14 June, 1904 ; no. 10).

281. CYMATOPLEURA NYANSÆ, sp. n. (Pl. **8.** fig. 8.)

C. magna et insignis ; cellula ut in visa aspectu valvulari in parte mediana angusta et subcylindrica, in partibus apicalibus valde inflatis subcircularibus, polis submamillatis ; costis ad margines laterales 7 in 10 μ ; cellula ut in visa aspectu cingulato ut in *C. Solea*.

Long. 189–195 μ ; lat. in med. 20 μ ; lat. max. (part. polar.) 56–58 μ.

Victoria Nyanza.—Not uncommon in the plankton, near Bukoba (April 1905; nos. 249 and 252).

This species is distinct from *C. Solea* by reason of its curious dumbbell-shaped valves. The median part of the valve is relatively narrow, and the polar portions are almost circular in outline.

Class **MYXOPHYCEÆ.**

Order HORMOGONEÆ.

Family **STIGONEMACEÆ.**

Genus NOSTOCHOPSIS, *Wood.*

282. NOSTOCHOPSIS GOETZEI, *Schmidle, in Bot. Centralbl.* lxxxi. (1900) p. 417.—Myxoderma Goetzei, *Schmidle, in Engl. Bot. Jahrb.* xxx. (1902) p. 246, t. 4. figs. 2, 3.

Crass. fil. prim. (cell. torulos.) 4–5 μ ; crass. ram. (cell. cylindr.) 2–3 μ ; crass. heterocyst. 5·5–6·5 μ.

Nyasa.—Taken in a shrimp-net in about 4 feet of water (15 June, 1904 ; no. 12).

The plants occurred in free-floating gelatinous masses of irregular outline, reaching a diameter of several cms. The main portions of the primary filaments were more or less torulose, and the cells were of very variable shape. The lateral branches consisted of cylindrical cells, 2½–4 times longer than the diameter, with slight constrictions between them. The apical cells were bluntly rounded. The heterocysts were invariably lateral, either sessile or stalked, the stalk consisting of one to three rounded cells. Each branch is attached to the side of one of the primary cells, from which it originally arose as a small lateral outgrowth.

The specimens collected by Dr. Cunnington agreed very well with Schmidle's description and figures, the plants he examined being collected in the vicinity of Nyasa in 1899.

I think Schmidle's genus *Myxoderma* must be regarded as synonymous with *Nostochopsis*, Wood. The only difference is in the form of the thallus, which is expanded in the one case (*N. Goetzei*) and more or less rounded in the other (*N. lobatus*), and to my mind this is not sufficient as a generic distinction. One of the most distinctive features of *Nostochopsis* is the lateral and often stalked condition of the heterocysts, and this is the same in each case. *N. lobatus*, Wood, is known to occur in Central Africa (*vide* W. & G. S. West, in Journ. Bot. xxxiv. (1896) p. 381, t. 361. figs. 1, 2 ; *op. cit.* xxxv. (1897) p. 264) ; and *N. Goetzei* differs from it in the more expanded thallus and consequent laxer disposition of the filaments, which in their inferior part are not arranged in parallel bundles.

Family **SCYTONEMACEÆ.**

Genus SCYTONEMA, *Ag.*

283. Scytonema mirabile, (*Dillw.*) *Born. in Bull. Soc. Bot. Fr.* xxxvi. (1889) p. 155 in obs.—Conferva mirabilis, *Dillw.* Scytonema figuratum, *Ag. Syst. Algar.* 1824, p. 38 ; *Born. & Flah. in Ann. Sci. Nat.* 7e sér., *Bot.* v. (1887) pp. 101–3.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

284. Scytonema crispum, (*Ag.*) *Born. l. c.* p. 156 in obs.—Lyngbya crispa, *Ag.* (pro parte). Scytonema cincinnatum, (*Kütz.*) *Thur. in Ann. Sci. Nat.* 6e sér., *Bot.* i. (1875) p. 380 ; *Born. & Flah. l. c.* (1887) p. 89.

Nyasa.—On rocks at water-level, Deep Bay (25 June, 1904 ; no. 26).

Tanganyika.—Among other Algæ scraped from bottom of Dr. Cunnington's dau (24 Jan. 1905 ; no. 217).

Genus TOLYPOTHRIX, *Kütz.*

285. Tolypothrix tenuis, *Kütz. Phyc. Gen.* p. 228 (1843); *em. J. Schmidt, in Bot. Tidsskr.* xxii. (1899) pp. 383 et 413.—*Inclus.* T. lanata, *Wartmann*, 1858.

Crass. fil. 11–14 μ ; crass. trich. 9–10 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; no. 72).

I thoroughly agree with Schmidt (*l. c.* 1899) regarding the identity of *Tolypothrix tenuis*, Kütz., and *T. lanata*, Wartm.

Family **NOSTOCACEÆ.**

Genus NOSTOC, *Vaucher.*

286. Nostoc paludosum, *Kütz. Tab. Phyc.* ii. (1850) p. 1, t. 1. fig. 2 ; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 164 ; *Born. & Flah. l. c.* (1888) p. 191.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

287. Nostoc piscinale, *Kütz. Phyc. general.* (1843) p. 208 ; *Tab. Phyc.* ii. p. 4, t. 11. fig. 3 (1846) ; *Born. & Flah. in Ann. Sci. Nat.* 7e ser., *Bot.* vii. (1888) p. 194.

Crass. trich. 4 μ ; crass. heterocyst. 5–6 μ ; diam. spor. 5·5–7·5 μ.

Tanganyika.—In plankton, Kituta Bay (24 Aug. 1904 ; no. 74). On surface of swamp, Toa (10 Jan. 1905 ; no. 209).

288. Nostoc carneum, *Ag. Syst. Algar.* 1824, p. 22 ; *Born. & Flah. l. c.* (1888) p. 186.

Crass. trich. 2·8–3·5 μ ; long. heterocyst. 10 μ; lat. heterocyst. 5·5 μ ; long. spor. 9–11·5 μ ; lat. spor. 5·7–6·5 μ.

Tanganyika.—In plankton, Kituta Bay (27 Aug. 1904 ; no. 82).

Genus ANABÆNA, *Bory.*

289. Anabæna Flos-aquæ, (*Lyngb.*) *Bréb. Alg. Eur. Falais.* p. 36 (1835); *Born. & Flah. l. c.* (1888) p. 228 ; *J. Schmidt, in Bot. Tidsskr.* xxii. (1899) p. 367.

Forma trichomatibus curtis, spiraliter dispositis, anfractibus arctis plerumque 2–4 ; cellulis globosis cum granulis conspicuis paucis ; heterocystis intercalaribus (non terminalibus) ; sporis non vidis.

Crass. trich. 6–7 μ ; crass. heterocyst. 7·5–8 μ. (Pl. **4**. figs. 10, 11, 14, 15 ; Pl. **10**. fig. 1.)

Nyasa.—In the plankton, Anchorage Bay (13 June, 1904 ; no. 9) and Monkey Bay (17 and 18 June, 1904 ; nos. 15 and 16) ; very abundant.

Tanganyika.—In the plankton, near Kalambo (5 Nov. 1904 ; no. 154), near Kirando (1 Dec. 1904 ; no. 175), and near Utinta (5 Dec. 1904 ; no. 181).

The trichomes are spirally twisted after the manner of a corkscrew, mostly making from 2 to 4 turns, rarely as many as 8. The cells are almost exactly globose, and the heterocysts were never observed to be terminal. It was the dominant feature of two of the Nyasa plankton collections.

This form may be the same as the *Anabæna* mentioned by Schmidle as occurring in Lake Nyasa, and for which he suggested the name "*A. Flos-aquæ*, forma *discoidea*" (*cf.* Schmidle, in Engl. Bot. Jahrb. xxxii. (1903) p. 61). It is, however, rather larger than the measurements he gives for the specimens collected by Dr. Fülleborn. It may also be identical with *A. spiroides*, Klebahn.

Dr. Cunnington states that on one occasion in Lake Nyasa, and on a few occasions in Lake Tanganyika, a yellow scum was present on the surface, which he attributed to immense quantities of an *Anabæna*. He thinks that this appearance was the same as that noted by Livingstone and more recently by Mr. J. E. S. Moore ('The Tanganyika Problem,' p. 323), who describes the surface as "appearing as if tinged with a fine golden dust." Mr. Moore,

however, says that the "yellow clouds" consisted of a large infusorian resembling a *Peridinium* or a *Colpodium*. The organism in question may have been a *Peridinium* or possibly *Botryococcus Braunii*, a Protococcaceous alga, which is the cause of similar coloration and "yellow clouds" in many European lakes.

Var. CIRCULARIS, var. n. (Pl. **4**. figs. 10, 11, 14, 15; Pl. **10**. fig. 2.)

Var. filis brevissimis, spiraliter dispositis anfractibus 1–1½, utroque fine heterocysta terminatis; cellulis sphæricis, oblongo-ellipticis vel oblongis, cum granulo magno (*gas-vac.*) in cellula unaquaque.

Crass. trich. 4·5–6 μ; crass. heterocyst. 5–8 μ.

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135), near Sumbu (13 Oct. 1904; no. 138), Vua Harbour (29 Oct. 1904; no. 150), near Kalambo (5 Nov. 1904; no. 154), near Kassanga (14 Nov. 1904; no. 159), near Chamaluki (15 Nov. 1904; no. 160); near Kala (19 Nov. 1904; no. 170), near Kirando (1 Dec. 1904; no. 175), near Maswa (14 Jan. 1905; no. 211), and near Baraka (24 Feb. 1905; no. 240).

This variety was the dominant feature of some of the plankton collections from Tanganyika, giving the collected sediment a decided blue-green colour. The trichomes are remarkable for their shortness, being mostly coiled in the form of a circle, sometimes overlapping at the extremities to form a spiral with about one and a half turns. Each end of this short trichome is terminated by a globular or ellipsoidal heterocyst, and both cells and heterocysts contain a single large granule, most probably of the nature of a gas-vacuole. The total length of the trichomes from heterocyst to heterocyst varies from 80 to 140 μ. Very rarely a straight (or almost straight) trichome is observed among the coiled ones. The cells are somewhat variable in form, showing all gradations from globose to oblong.

290. ANABÆNA sp. (Pl. **9**. fig. 8.)

A. trichomatibus rectis rigidissimis, evaginatis, solitariis; cellulis sphærico-compressis, cytoplasmate atro-viridi et minute granulato; heterocystis sphæricis, diametro trichomatis subæqualibus; sporis non visis. Forsan sit propria species: *A. rigidissima.*

Crass. trich. 11–12 μ.

Victoria Nyanza.—Among *Utricularia*, near Bukoba (20 Apr. 1905; no. 618).

Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170).

The trichomes of this *Anabæna* were remarkable for their exactly lineal character.

291. ? ANABÆNA INÆQUALIS, (*Kütz.*) *Born. & Flah. in Ann. Sci. Nat.* 7ᵉ sér., *Bot.* vii. (1888) p. 231.—Sphærozyga inæqualis, *Kütz.* (1843).

Crass. trich. 3·5–4 μ; crass. heterocyst. 6 μ; sporis non vidis.

Nyasa.—In swamp, Kambwelagoon near Karonga (27 June, 1904; no. 29).

292. Anabæna Tanganyikæ, sp. n. (Pl. **10.** fig. 3.)

A. pelagica, trichomatibus brevissimis, spiraliter contortis anfractibus 1–2 (plerumque circ. $1\frac{1}{5}$), evaginatis, inter cellulas non constrictis, utroque fine heterocysta terminatis; cellulis cylindricis, diametro 2–3-plo longioribus (3·5–8·5 μ longis), utroque polo truncatis; cytoplasmate minute granulato, pallide æruginoso; heterocystis oblongo-ellipticis terminalibus; sporis ellipticis, solitariis?, ab heterocystis plerumque remotis, episporio lævi et hyalino.

Crass. trich. 2·4–2·6 μ; long. heterocyst. 5·5 μ; lat. heterocyst. 3 μ; long. spor. 13 μ, lat. 7 μ.

Tanganyika.—In plankton, near Baraka (24 Feb. 1905; no. 240).

This species presents a similar modification of the trichomes to that shown by *A. Flos-aquæ* var. *circularis.* Each trichome is short and twisted into a spiral of rather more than one complete revolution, and each extremity is terminated by a heterocyst. Beyond this point, however, the resemblance ceases. *A. Tanganyikæ* is a very much narrower species, with exactly cylindrical cells and scarcely any trace of constrictions between them.

In the thickness of its trichomes it most nearly approaches *A. hyalina*, Schmidle, but is very different in other characters and in its habit.

293. Anabæna sphærica, *Born. & Flah. in Ann. Sci. Nat.* 7ᵉ sér., *Bot.* vii. (1888) p. 228.

Forma tenuis: crass. trich. 4–5 μ; crass. heterocyst. 5·5 μ; long. spor. 11–14 μ; lat. spor. 10 μ.

Nyasa.—Among *Utricularia,* Domira Bay (19 June, 1904; no. 579).

The filaments are rigid and straight, and except for being a trifle thinner agree in every particular with the description of *A. sphærica.* It is similar in size to *A. baltica*, J. Schmidt, but the trichomes of the latter are strongly flexuose and circinate, and the spores are relatively larger.

294. Anabæna sp. ad *A. balticam*, J. Schmidt, accedens; trichomatibus valde flexuoso-circinatis; cellulis globosis, diam. 3–3·5 μ; sporis non vidis.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904; no. 9).

Genus NODULARIA, *Mertens.*

295. Nodularia sphærocarpa, *Born. & Flah. l. c.* (1888) p. 245.

Crass. trich. 6 μ.

Tanganyika.—On surface of swamp, Toa (10 Jan. 1905; no. 208).

296. Nodularia tenuis, sp. n.

N. filis tenuibus, brevibus et rigidis, utroque fine paullo attenuatis et cellula acute conica terminatis; vagina tenerrima, hyalina et diffluente, vix conspicua; cellulis ante divisionem diametro æquilobis, rotundo-quadratis; heterocystis late ellipsoideis; sporis . . . . ?

Crass. trich. 3–3·8 μ; crass. heterocyst. 5·5–6 μ; long. heterocyst. 7 μ.

Tanganyika.—Among various Algæ, floating, Komba Bay (10 Nov. 1904; no. 134).

The spores of this species were not observed, but it differs so much from previously described plants of this genus that I feel justified in naming it *Nodularia tenuis*.

The trichomes are thinner than those of *N. Harveyana*, (Thw.) Thur., the cells are rounded quadrate, and the apical cells are acutely conical. The heterocysts are very numerous, broadly elliptical in form, and situated about 110–120 μ apart.

297. NODULARIA sp.

Crass. cell. veget. (trich.) 6–7 μ; crass. heterocyst. 10–11 μ; sporis non vidis.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

298. NODULARIA sp.

Crass. trich. 4–4·5 μ; cellulis depresso-quadratis; heterocystis late ellipticis, long. 7·5–9 μ, lat. 6–7 μ; cellula apicali hemisphærica; sporis non vidis.

Tanganyika.—Among *Cladophora* sp., on stones, shells, roots of grasses, etc., Niamkolo (1 Aug. 1904; no. 44).

Genus CYLINDROSPERMUM, *Kütz.*

299. CYLINDROSPERMUM GOETZEI, *Schmidle, in Engl. Bot. Jahrb.* xxx. (1902) p. 245, t. 4. fig. 5.

Crass. trich. 2·2–3 μ; cellulis diametro $1\frac{1}{4}$–2-plo longioribus; long. heterocyst. 8–9 μ; lat. heterocyst. 3–3·8 μ; long. spor. 19–28 μ; lat. spor. 6·2–9·2 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

This characteristic species was abundant in stagnant water. It is chiefly remarkable for its narrow trichomes and the length of the heterocysts.

Family OSCILLATORIACEÆ.

Subfam. VAGINARIEÆ.

Genus SCHIZOTHRIX, *Kütz.*

300. SCHIZOTHRIX LACUSTRIS, *A. Br. in Kütz. Sp. Alg.* (1849) p. 320; *Gomont, in Ann. Sci. Nat.* 7e sér., *Bot.* xv. (1892) p. 301, t. 6. figs. 9–12.

Crass. trich. 1·2–1·4 μ.

Tanganyika.—On rocks, in a few fathoms, Niamkolo Harbour (9 Aug. 1904; no. 54).

Genus MICROCOLEUS, *Desmaz.*

301. MICROCOLEUS VAGINATUS, (*Vauch.*) *Gomont, in Morot, Journ. de Bot.* iv. (1890) p. 353 ; *Ann. Sci. Nat.* 7ᵉ sér., *Bot.* xv. (1892) p. 355.

Var. MONTICOLA, (*Kütz.*) *Gomont.*—Chthonoblastus monticola, *Kütz.*
Crass. trich. 3·6–4 μ.
Nyasa.—On rocks, Nkata Bay (23 June, 1904 ; no. 23).

Subfam. LYNGBYEÆ.

Genus PLECTONEMA, *Thur.*

302. PLECTONEMA WOLLEI, *Farlow, in Bull. Bussey Inst.* (1875) p. 77 ; *Gomont, l. c.* xvi. (1893) p. 98, t. 1. fig. 1.—Lyngbya Wollei, *Farlow* (1876).
Crass. fil. 32–52 μ ; crass. trich. 27–42 μ.
Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36), Komba Bay (11 Oct. 1904 ; no. 135), and near Sumbu (13 Oct. 1904 ; no. 138).
Forma robusta : crass. fil. 60–80 μ ; crass. trich. 42–59 μ.
Tanganyika.—Floating and dredged, Komba Bay (10 Oct. 1904 ; no. 134). This stout form was loaded with epiphytes.

303. PLECTONEMA TOMASINIANUM, (*Kütz.*) *Born. in Bull. Soc. Bot. France,* xxxvi. (1889) p. 155 in obs. ; *Gomont, l. c.* p. 99.
Crass. fil. 18–23 μ ; crass. trich. 15–17 μ.
Tanganyika.—With the preceding species (no. 134).

Genus LYNGBYA, *C. Ag.*

304. LYNGBYA PUTEALIS, *Montagne, in Ann. Sci. Nat.* sér. 2, *Bot.* xiii. (1840) p. 200 ; *Gomont, l. c.* p. 143, t. 3. fig. 14.
Crass. fil. 9·5–10·2 μ ; crass. trich. 7–7·8 μ.
Tanganyika.—On shells, dredged in about 10 fathoms, Pemba (23 Nov. 1904 ; no. 174).

305. LYNGBYA MARTENSIANA, *Meneghini, Consp. Alg. Eugan.* (1837) p. 12; *Gomont, l. c.* p. 145, t. 3. fig. 17.—Oscillatoria turfosa, *Carm.* (1841).
Crass. fil. 8 μ ; crass. trich. 6 μ.
Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904 ; no. 114).

306. LYNGBYA VERSICOLOR, (*Wartm.*) *Gomont, l. c.* p. 147, t. 4. figs. 4, 5.
Crass. fil. 3·8–4·5 μ ; crass. trich. 2·8–3·3 μ.
Nyasa.—On rocks, Nkata Bay (23 June, 1904 ; no. 23). Amongst various Algæ scraped from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 ; no. 577).

Victoria Nyanza.—On rocks, Bukoba (17 Apr. 1905 ; no. 248).

Tanganyika.—On rocks in shallow water, Mbete (29 Sept. 1904 ; no. 114).

307. LYNGBYA ÆRUGINEO-CŒRULEA, (*Kütz.*) *Gomont, Ann. Sci. Nat.* 7e sér., *Bot.* xvi. (1892) p. 146, t. 4. figs. 1–3.

Tanganyika.—On rocks, Niamkolo Harbour (7 Sept. 1904 ; no. 87).

308. LYNGBYA KÜTZINGII, *Schmidle, in Allgem. Bot. Zeitschr.* iii. (1897) p. 58.—Leibleinia Martensiana, *Kütz. Tab. Phyc.* i. p. 45, t. 82. fig. 1. Lyngbya Martensiana, *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 143.

Var. DISTINCTA, (*Nordst.*) *Lemm. in Engl. Bot. Jahrb.* xxxiv. (1905) p. 620.—L. Martensiana, *β*. distincta, *Nordst. Alg. Sandvic.* p. 4. L. subtilis, *West, in Journ. Roy. Micr. Soc.* (1892) p. 741, t. 10. fig. 58. L. distincta, *Schmidle, l. c.*

Victoria Nyanza.—Among *Utricularia*, swampy pool near Bukoba (20 Apr. 1905 ; no. 618) and in sheltered bay near Entebbe (1 May, 1905 ; no. 620).

309. LYNGBYA CIRCUMCRETA, sp. n. (Pl. 9. fig. 7.)

L. filis solitariis pelagiis et brevibus, spiraliter contortis ; spiris latis et arctissimis, anfractibus adnatis 2–9 (plerumque 2–2½) ; vaginis tenuibus, firmis, arctissimis et achrois ; cellulis subquadratis vel diametro brevioribus, cytoplasmate pallide ærugineo et homogeneo ; cellula apicali rotundo-truncata.

Crass. cell. 1·8–2·1 μ ; long. cell. 1–2 μ ; diam. anfract. 28–44 μ.

Victoria Nyanza.—In plankton, near Bukoba (April 1935 ; nos. 249 and 252). Also in sheltered bay near Entebbe (1 June, 1905 ; no. 620).

This species occurred floating in the plankton as closely coiled threads which have the appearance of small hoops. The filament grows in the manner of a flat spiral, the twists of the spiral being wide but very close together.

It is nearest to *L. contorta*, Lemm., but differs in the hoop-like coiling of its filaments, which are also of greater thickness, and in the much shorter cells. The coils of *L. circumcreta* are much wider than those of *L. contorta* and more exactly circular.

310. LYNGBYA PURPUREA, *Gomont, l. c.* (1892) p. 149.—Oscillatoria purpurea, *Hook. f. & Harv.*

Crass. trich. 1·7 μ.

Tanganyika.—Among *Calothrix cartilaginea*, sp. n., on inside of canoe (6 Jan. 1905 ; no. 205).

311. LYNGBYA BIPUNCTATA, *Lemm. in Forschungsb. Biol. Stat. Plön*, vi. (1900) p. 138, t. 2. fig. 48 ; *l. c.* x. (1903) p. 152.

a. Crass. trich. 1·4–1·5 μ ; long. cell. 3·5–5·5 μ.

Nyasa.—In plankton, near Mtangula (22 June. 1904 ; no. 20), and off

Vahambwera Point (24 June, 1904; no. 24). In swamp, Kambwelagoon near Karonga (27 June, 1904; no. 29).

b. Crass. trich. 1 μ; long. cell. 5–6 μ.

Tanganyika.—In plankton, Lofu River (5 Oct. 1904; no. 124).

This minute *Lyngbya* exhibited considerable variation. The range of diameter was from 1 μ to 1·5 μ, and the length of the cells from 3·5 to 6 μ. In all cases a strong puncta or large granule was visible on each side of the dissepiments. In some instances the filaments were regularly twisted into a lax spiral, in others they were only curved, and very rarely they were almost straight. The spiral specimens only differed from *L. Lagerheimii*, (Möb.) Gomont, in the slightly longer cells, and in some of them the apical cells were very slightly narrowed and faintly capitate as in *L. Nyassæ*, Schmidle.

I place the plants observed under *L. bipunctata*, Lemm., mainly owing to the length of the cells. They appear to me to combine the characters of *L. Lagerheimii*, *L. bipunctata*, and *L. Nyassæ*, three Lyngbyas which would perhaps be better regarded as constituting one species with well-marked punctæ and with filaments which frequently become twisted into a lax spiral. Particularly interesting was the finding of narrowed and faintly capitate apical cells in the spirally twisted forms. Precisely the same plant was observed from stones in a swamp as occurred in the plankton.

312. Lyngbya perelegans, *Lemm. in Abh. Nat. Ver. Bremen*, xvi. (1899) p. 355; xviii. (1904) p. 153, t. 11. figs. 13, 14.

Crass. cell. 1·5–1·8 μ.

Tanganyika.—In plankton, Niamkolo (Aug. 1904; nos. 39 and 52) and near Kala (19 Nov. 1904; no. 170).

313. Lyngbya limnetica, *Lemm. in Bot. Centralb.* lxxvi. (1898) p. 154; *Forschungsb. Biol. Stat. Plön*, x. (1903) p. 151.

Tanganyika.—In plankton off Niamkolo Island (29 July, 1904; no. 36).

Genus PHORMIDIUM, *Kütz.*

314. Phormidium foveolarum, (*Mont.*) *Gomont, in Ann. Sci. Nat.* 7e sér., *Bot.* xvi. (1892) p. 164, t. 4. fig. 16.

Crass. trich. 1·4–1·8 μ.

Tanganyika.—Epiphytic on *Plectonema Wollei*, Komba Bay (10 Oct. 1904; no. 134). On rocks, among *Lyngbya Martensiana* and *L. versicolor*, Mbete (29 Sept. 1904; no. 114). On rocks dredged in 2 or 3 fathoms, Niamkolo Harbour (7 Sept. 1904; no. 87).

The varied habit of this species is worthy of comment.

315. Phormidium tenue, (*Menegh.*) *Gomont*, *l. c.* p. 169, t. 4. figs. 23–25.

Tanganyika.—On stones, shores of lake Niamkolo (1 Aug. 1904; no. 44). In swamp, Kituta (23 Aug. 1904; no. 72). Near Kala, both in the plankton

and dredged from the bottom (19 Nov. 1904; nos. 170 and 171). In swampy pond, Mrumbi (27 Dec. 1904; no. 195). In swamp, Toa (10 Jan. 1905; no. 208). In plankton near Baraka (24 Feb. 1905; no. 240).

316. PHORMIDIUM ANGUSTISSIMUM, *W. & G. S. West, in Journ. Bot.* xxxv. (1897) p. 72.

Crass. trich. 0·8 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, near Kala (19 Nov. 1904; no. 170). In swamp, Toa (10 Jan. 1905; no. 208). In plankton, middle of lake between Rumonge and Uvira (30 Jan. 1905; no. 218). Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905; no. 611).

317. PHORMIDIUM CORIUM, *(Ag.) Gomont, in Morot, Journ. de Bot.* iv. (1890) p. 355; *Ann. Sci. Nat.* 7ᵉ ser., *Bot.* xv. (1892) p. 172, t. 5. figs. 1, 2.

Crass. trich. 3·8 μ.

Tanganyika.—On rocks below the water-level, Kassanga (10 Nov. 1904; no. 156).

318. PHORMIDIUM PAPYRACEUM, *(Ag.) Gomont, ll. cc.* p. 355; p. 193, t. 5. figs. 3, 4.

Crass. trich. 3·6 μ.

Tanganyika.—Epiphytic on *Plectonema Wollei*, Komba Bay (10 Oct. 1904; no. 134).

319. PHORMIDIUM INUNDATUM, *Kütz. Sp. Alg.* (1849) p. 251; *Tab. Phyc.* i. p. 32, t. 45. fig. 3; *Gomont, l. c.* (1892) p. 172, t. 4. figs. 31, 32.

Crass. trich. 3–4·3 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 33).

320. PHORMIDIUM AMBIGUUM, *Gomont, l. c.* (1892) p. 198, t. 5. fig. 10.

Crass. trich. 5·5–6 μ.

Tanganyika.—On rocks dredged in 2 or 3 fathoms, Niamkolo Harbour (7 Sept. 1904; no. 87), and on rocks just below water-level, Kassanga (10 Nov. 1904; no. 156).

321. PHORMIDIUM AUTUMNALE, *(Ag.) Gomont, l. c.* (1892) p. 187, t. 5. figs. 23, 24; *J. Schmidt, in Bot. Tidsskr.* xxii. (1899) pp. 348, 410.—Phormidium uncinatum, *(Ag.) Gomont*, 1890; *l. c.* (1892) p. 184, t. 5. figs. 21, 22.

Crass. trich. 5·8–6·2 μ.

Tanganyika.—On rocks, shallow water, Mbete (29 Sept. 1904; no. 114).

Genus OSCILLATORIA, *Vauch.*

322. OSCILLATORIA PRINCEPS, *Vauch. Hist. Conf.* (1803) p. 190 ; *Gomont, in Ann. Sci. Nat.* 7e sér., *Bot.* xv. (1892) p. 206, t. 6. fig. 9.

Tanganyika.—In plankton, Kituta Bay (27 Aug. 1904 ; no. 82).

323. OSCILLATORIA TENUIS, *Ag. Alg. Del.* ii. (1813) p. 25 ; *Gomont, l. c.* p. 220, t. 7. figs. 2, 3.

Victoria Nyanza.—In swampy pools, Bukoba (20 Apr. 1905 ; no. 251).

Tanganyika.—In plankton, near Mbete (28 Sept. 1904; no. 105). Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

324. OSCILLATORIA AMPHIBIA, *Ag. in Flora*, x. (1827) p. 632 ; *Gomont, l. c.* p. 221, t. 7. figs. 4, 5.—Oscillaria tenerrima, *Kütz.* (1843).

Crass. trich. 3 μ.

Victoria Nyanza.—Swampy pool near Bukoba (20 Apr. 1905 ; no. 618).

325. OSCILLATORIA GEMINATA, *Menegh. Consp. Alg. Eugan.* (1837) p. 9 ; *Gomont, l. c.* p. 222, t. 7. fig. 6.

Crass. trich. 3 μ.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 34).

326. OSCILLATORIA SPLENDIDA, *Grev. Fl. Edinb.* p. 305 (1824); *Gomont, l. c.* p. 224, t. 7. figs. 7, 8.—Oscillaria leptotricha, *Kütz. Phyc. Germ.* (1845) p. 157.

Var. ATTENUATA, *W. & G. S. West, in Journ. Roy. Micr. Soc.* ser. 2, xvi. (1896) p. 165, t. 4. fig. 58.

Crass. trich. 2·3 μ.

Tanganyika.—Among *Utricularia*, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

327. OSCILLATORIA TANGANYIKÆ, sp. n. (Pl. **9**. fig. 9.)

O. trichomatibus solitariis natantibus et pelagiis, elongatis, olivaceo-viridibus, rectis vel subrectis, apicem versus longe attenuatis, apicibus curvatis vel interdum recurvatis, rotundatis vel rotundo-truncatis, inter cellulas constrictis ; cellulis subquadratis vel plerumque leviter brevioribus, apicem versus ad duplo longioribus ; cytoplasmate minute granuloso et interdum granulis magnis subrefringentibus (*gas-vac.?*) paucis farcti ; cellula apicali plerumque valde curvata, nunquam capitata, extremitati rotundata vel subtruncata ; calyptra nulla.

Crass. trich. 10–12 μ ; crass. apic. trich. 6 μ; long. cell. 6–10 μ ; long. cell. apical. 11–15 μ.

Tanganyika.—In plankton, near Kirando (1 Dec. 1904 ; no. 175) and near Baraka (24 Feb. 1905 ; no. 240).

This interesting *Oscillatoria* most nearly approaches *O. subuliformis*, Kütz.,

a species which occurs on maritime rocks about the tide-limits. It is, however, distinguished by its thicker and much straighter trichomes, by the conspicuous constrictions between the cells, and by its free-floating habit. *O. Tanganyikæ* is a remarkable species and has undoubtedly a closer affinity with *O. subuliformis* than with any other known species of the genus. So striking is this resemblance, and so different is *O. Tanganyikæ* from other species of the genus, that one feels justified in suggesting that these two species have had a common origin, *O. Tanganyikæ* having acquired certain distinctive characters as a result of its adaptation to a pelagic existence.

328. Oscillatoria subbrevis, *Schmidle, in Engl. Bot. Jahrb.* xxx. (1902) p. 243, t. 4. fig. 7.

Forma major ; crass. trich. 10–10·5 μ.

Tanganyika.—In swamp, Mbete (28 Sept. 1904 ; no. 108).

The specimens from Tanganyika are in perfect agreement with Schmidle's species except for the thickness. The trichomes are straight, with unattenuated and bluntly rounded extremities, and the cells are exceedingly short. The transverse cell-walls are bent as in specimens of *O. subbrevis* which I have recorded from Barbados in the West Indies (*vide* Journ. Bot. xlii. (1904) p. 292), some of them being concave and some convex to the apex of the trichome. The dark disc-shaped masses of intercellular (?) substance occur at irregular intervals along the length of the trichome.

329. Oscillatoria formosa, *Bory, Dict. Cl. Hist. Nat.* xii. (1827) p. 474; *Gomont, in Ann. Sci. Nat.* 7e sér., *Bot.* xv. (1892) p. 230, t. 7. fig. 16.

Crass. trich. 4–4·2 μ.

Tanganyika.—Dredged from a few fathoms, near Kala (19 Nov. 1904 ; no. 171).

330. Oscillatoria Cortiana, *Meneghini, l. c.* p. 8 ; *Gomont, l. c.* p. 231, t. 7. fig. 17.

Crass. trich. 7–7·5 μ.

Tanganyika.—In plankton, near Maswa (14 Jan. 1905 ; no. 11).

Previously recorded only from thermal waters in Italy and Hungary.

Genus SPIRULINA, *Turp.*

331. Spirulina tenuissima, *Kütz. Alg. Decad.* xiv. (1836) no. 131 ; *Tab. Phyc.* i. p. 26, t. 37. fig. 4.—S. subsalsa, *Œrsted* (1842) ; *Gomont, l. c.* p. 253, t. 7. fig. 32.

Nyasa.—On stones on shore, Domira Bay (19 June, 1904 ; no. 17).

332. Spirulina laxissima, sp. n. (Pl. **9.** fig. 6.)

Trichomata angustissima, solitaria, inter algas pelagias sparsas, in spiram laxissimam regularem diametro 4·5–5·3 μ æqualiter contorta, anfractibus 17–22 μ inter se distantibus ; apicibus trichomatis rotundo-obtusis ; cytoplasmate pallide æruginoso et homogeneo, sine granulis.

Crass. trich. 0·7–0·8 μ; long. tot. trich. 21–275 μ.

Tanganyika.—In plankton, near Chamkaluki (15 Nov. 1904; no. 160) and near Kala (19 Nov. 1904; no. 170).

This species occurred in abundance in the two above-mentioned collections. The trichomes are exceedingly narrow and are chiefly remarkable for the laxness of the spirals. Some of them were very short, scarcely exceeding a single turn of the spiral, whereas others possessed as many as fourteen turns and reached a length of 275 μ.

333. Spirulina Princeps, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* vi. (1902) p. 205.—S. Gomontii, *Gutw. in Bull. Acad. Sci. Cracov.* (1902) p. 613, t. 40. fig. 69. S. gigantea, *Schmidle, in Engl. Bot. Jahrb.* xxxii. (1903) p. 59, t. 1. fig. 5.

Crass. trich. 3·5–4·8 μ. (Pl. **9**. fig. 5.)

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

This species has a wide distribution in the tropics, having been described from Java, Ceylon, and Central Africa. Unfortunately, it was described as a "sp. nova" in each case, the name *Spirulina princeps* being the first one given to it.

The cell-contents are of a bright blue-green colour, and homogeneous in character except for a few scattered refractive granules, which are rarely absent. The trichomes are slightly variable in thickness, and in the width of the spiral and relative distance apart of the turns, but to my mind these differences are not of a specific nature. The width of the spiral varies within the extremes even in a single trichome, and the distance between the turns of the spiral varies at different parts of the same trichome.

The following table shows the differences of measurement between the described forms:—

Locality.	Thickness of trichome.	Diameter of spiral.	Distance apart of turns.
Java (*Sp. Gomontii* of Gutwinski).	3·8 μ	8·8 μ	11 μ
Ceylon.	4·5–5 μ	11–12 μ	9·5 μ
Africa (Nyasa) (*Sp. gigantea* of Schmidle).	3–4 μ	11–16 μ	
Africa (Nyasa) (coll. by Dr. Cunnington).	3·5–4·8 μ	9–12 μ	10–12 μ

The following diagnosis takes into consideration the limits of variation for the species:—

Trichomata robusta et solitaria, inter algas varias sparsas, curta, in spiram laxam vel laxiusculam plus minusve subregulariter diametro 8·8–16 μ contorta; anfractibus 9·5–11 μ inter se distantibus; apicibus trichomatis obtusis vel rotundato-obtusis; cytoplasmate ærugineo-cœruleo et homogeneo, cum granulis minutis sparsis. Crass. trich. 3–5 μ.

Geogr. distribution.—Central Africa; Ceylon; Java.

Family **RIVULARIACEÆ.**

Genus CALOTHRIX, *Ag.*

334. CALOTHRIX JULIANA, (*Menegh.*) *Born. & Flah. in Ann. Sci. Nat.* 7ᵉ sér., *Bot.* iii. (1886) p. 348.

Crass. fil. 10–12 μ (ad 16 μ); crass. trich. ad bas. 7–9·3 μ.

Nyasa.—In scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904; no. 577).

335. CALOTHRIX EPIPHYTICA, *W. & G. S. West, in Journ. Bot.* xxxv. (1897) p. 240.

Crass. fil. ad bas. 4·5–9 μ; crass. trich. ad bas. 2·8–5·8 μ.

Nyasa.—On *Cladophora*, Anchorage Bay (no. 11).

Tanganyika.—On *Cladophora* scraped from the bottom of Dr. Cunnington's dau (24 Jan. 1905; no. 216).

336. CALOTHRIX BREVISSIMA, sp. n. (Pl. **10**. fig. 8.)

C. filis minutis et epiphyticis, culmis vetustis pelagiis affixis, gregariis et brevissimis, longitudine toto 53–94 μ, *non vel levissime attenuatis*; vagina firma, arcta, pæne cylindrica, tenui, hyalina et achroa; trichomatibus pallide olivaceo-viridibus, brevissimis, longitudine toto 30–62 μ, vix attenuatis, apice rotundato; cellulis inferioribus diametro subæquilongis vel brevioribus, superioribus diametro duplo brevioribus, minute granulatis; heterocystis basilaribus singulis (rare binis) rotundato-hemisphæricis vel subglobosis.

Crass. fil. 5–7 μ; crass. trich. 3·8–5 μ.

Victoria Nyanza.—In the plankton, attached to decaying shreds of vegetable matter (probably old leaves and plant-stems), near Bukoba (21 Apr. 1906; no. 252).

This minute species occurred clustered round fragments of decaying stems and leaves which had collected in the tow-net. It is characterized by its extreme shortness, and is distinguished from all other species of the genus by the absence of any appreciable attenuation. The sheaths are firm and colourless, almost cylindrical, with open extremities, and they fit the trichomes very closely. The trichomes are rounded at both extremities, with the faintest indication of attenuation towards the apex, and the cells are much shorter than their length. There is a well-defined basal heterocyst of a

rounded-hemispherical shape, and sometimes a second heterocyst is developed after the trichome has shifted a short distance from the base of the sheath.

Forma angustior et longior.

Crass. fil. ad bas. 4–5·5 μ ; crass. trich. 3·4–3·7 μ ; long. toto fil. usque 130 μ.

Tanganyika.—Epiphytic on *Cladophora inconspicua*, clothing some of the young branches very thickly, in a few fathoms of water, Niamkolo.

337. CALOTHRIX PARIETINA, (*Kütz.*) *Thur. in Ann. Sci. Nat.* 6e sér. *Bot.* i. (1875) p. 381 ; *Born. & Flah. l. c.* 7e sér. *Bot.* iii. (1886) p. 366.

Crass. fil. ad bas. 13·5–19 μ ; crass. trich. 7·5–9·5 μ.

Victoria Nyanza.—On rocks just below the water-level, Bukoba (17 Apr. 1905 ; no. 248). This form approaches a species of *Tolypothrix*.

338. CALOTHRIX BRAUNII, *Born. & Flah. l. c.* (1886) p. 368.

Crass. fil. ad bas. 7–10 μ ; crass. trich. 5·5–8 μ.

Tanganyika.—Among *Utricularia* and other water-weeds in shallow water, mouth of Malagarasi River (16 Jan. 1905 ; no. 611).

Forma filis ad basin subrectis.

Crass. fil. ad bas. 6–9 μ ; crass. trich. 4·5–6·4 μ.

Nyasa.—On rocks below level of water, Nkata Bay (23 June, 1904 ; no. 23).

339. CALOTHRIX CARTILAGINEA, sp. n. (Pl. **10**. fig. 7.)

C. strato compacto late expanso, cartilagineo, atro-viridi vel sordide ærugi-noso, lignis vetustis affixo, 1 mm. crasso ; filis densissime confertis, curvato-flexuosis, imbricatis, plerumque curtis, ad basin leviter bulboso-inflatis ; vagina arcta et firma, hyalina, sæpe vix conspicua ; trichomatibus brevibus, in pilum brevem attenuatis, inter cellulas constrictis ; cellulis inferioribus diametro paullo brevioribus (rare triplo brevioribus disciformibus), plerumque torulosis, superioribus tam longis quam latis vel diametro usque duplo longi-oribus, cellula basali parva, cellula apicali subconica ; *heterocystis nullis*.

Crass. fil. ad bas. 5–10 μ ; crass. trich. ad bas. 4·5–9 μ ; hormogoneis toru-losis usque 50 μ longis.

Tanganyika.—Scraped from the inside of a canoe (6 Jan. 1905 ; no. 205).

The trichomes of this species are rather short and somewhat variable in character. There are no heterocysts and the basal cell is generally consider-ably smaller than the cells just above it, a slight bulbous swelling being a general feature of the base of the trichome. The basal cells are shorter than their length, but in the upper parts of the trichome the cells are mostly longer than broad. In some of the trichomes each cell contains one or more promi-nent granules of large size, and occasionally in some of the thinner trichomes the basal region does not appear to be septate.

Calothrix cartilaginea should be compared with *C. balearica*, Born. & Flah., and *C. juliana*, Born. & Flah. From the former it is distinguished by the swollen bases of its trichomes, which are never decumbent, and by the much thinner sheath with no trace of lamellation. The cells are also considerably longer. From *C. juliana* it differs in its thinner stratum of darker colour, its narrower, much shorter, and more flexuose trichomes, and its longer cells.

Genus RIVULARIA, (*Roth*) *Ag.*; *em. Thur.*

340. Rivularia dura, *Roth*, *Neu. Beitr.* p. 273 (1802); *Born. & Flah. in Ann. Sci. Nat.* 7 sér., *Bot.* iv. (1886) p. 347.

Forma: crass. trich. 5·5–7 μ; crass. heterocyst. 5·5–6 μ.

Tanganyika.—Attached to floating decayed stems, Lofu River (5 Oct. 1904; no. 124).

341. Rivularia globiceps, sp. n. (Pl. **10**. fig. 6.)

R. thallo parvo, submolle, 1·5–3 mm. lato, calce non indurato, hemisphærico-globoso, caulibus vetustis affixo; filis confertis pressione facile secedentibus; vaginis hyalinis et amplis, vix conspicuis; trichomatibus inter cellulas constrictis, apice in pilum sublongum attenuatis; cellulis cylindricis inferioribus diametro 1½–4-plo longioribus, superioribus similibus vel duplo brevioribus, cum granulis paucis magnis; heterocystis magnis globosis, singulis vel rare binis, cum nodulo incrassato conspicuo juxta cellulam basalem.

Crass. trich. ad bas. 4·8–6 μ; crass. heterocyst. 10–12 μ.

Tanganyika.—Attached to old stems and leaves, floating in Kituta Bay (24 Aug. 1904; no. 74).

The large size of the heterocysts, which are globular and twice the diameter of the trichomes, is one of the most characteristic features of this species. The cells are cylindrical and in the basal parts of the trichomes are very long. They contain scattered conspicuous granules, which are chiefly located near the exterior, sometimes even projecting from the wall of the cell.

In the size of its trichomes *R. globiceps* most nearly approaches *R. hæmatites*, Ag., but it is at once distinguished by its smaller and much softer colonies, which are not incrusted with lime, by the large size of the heterocysts, and by the somewhat longer basal cells.

Genus GLŒOTRICHIA, *J. Ag.*

342. Glœotrichia natans, (*Hedwig*) *Rabenh. Deutschl. Kryptogamenfl.* p. 90 (1847); *Born. & Flah. l. c.* (1886) p. 369.

Forma thallo bulloso usque ad 15 mm. lato; vaginis plerumque diffluent-

ibus ; heterocystis basilaribus, singulis, binis vel ternis, globosis, late ellipticis vel oblongis.

Crass. trich. ad bas. 7–9·5 μ ; diam. heterocyst. 8·2–12·4 μ.

Tanganyika.—Floating in Mtondwe Bay, Niamkolo (13 Aug. 1904 ; no. 66).

Forma juvenalis ?

G. thallo minuto subgloboso 170–230 μ lato molle et solido ; trichomatibus olivaceis viridibus, curtis, in pilum brevem attenuatis ; cellulis basin versus subrectangularibus (diametro 1¼–1¾-plo longioribus) levissime tumidis, superioribus diametro usque 5-plo longioribus, valde granulosis ; heterocystis basilaribus globosis ; sporis ignotis.

Crass. trich. ad bas. 3–3·4 μ ; crass. heterocyst. 5·5–6 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905 ; no. 620).

343. Glœotrichia longiarticulata, sp. n. (Pl. **10**. fig. 5.)

G. thallo parvo subgloboso molle 750–900 μ lato ; filis subconfertis, pressione facile secedentibus ; trichomatibus læte æruginosis, in pilum sublongum attenuatis, inter cellulas distincte constrictis ; cellulis cylindricis, ad basin plerumque elongatis, diametro 3–7-plo longioribus (rare 1½-plo longioribus), superioribus sæpe brevioribus (diametro 3–5-plo longioribus), nonnunquam granulo magno conspicuo ad polum unumquemque et cum granulis minutis numerosis ; heterocystis basilaribus, magnis, globosis vel late ellipticis (rare oblongis) ; sporis breviter cylindricis, diametro 3-plo longioribus, polis rotundatis, episporio duplicato glabro et lutescente.

Crass. trich. ad bas. 4·5–5·5 μ ; crass. heterocyst. 8–9·5 μ ; long. spor. 36–44 μ ; lat. spor. 12·5–15 μ.

Nyasa.—Floating in Anchorage Bay (10 June, 1904 ; no. 1).

This species is nearest to *Glœotrichia indica*, Schmidle (in Hedwigia, xxxix. (1900) p. 174, t. 9. figs. 18, 19), from which it differs in the shorter filaments, in the absence of swollen cells next the heterocyst at the base of the trichome, and in the smooth outer coat of the spore. The spores are also shorter and the heterocysts more rounded.

There are well-marked constrictions between the cells, and the large granule (gas-vacuole ?) at each pole is particularly conspicuous in the more elongated cells. The heterocysts are mostly of a broadly-elliptic shape and are markedly wider than the trichomes.

G. longiarticulata differs from *G. echinulata* (*Conferva echinulata*, Sm., Engl. Bot. t. 1378 ; *Rivularia echinulata*, Turn. ex Sm. l. c. in obs.), P. Richter (*vide* J. Schmidt, in Bot. Tidsskr. xxii. (1899) p. 401), in the narrower trichomes, with much longer cells, and in the shorter spores.

Order COCCOGONEÆ.

Family CHAMÆSIPHONIACEÆ.

Genus CHAMÆSIPHON, *A. Br. & Grun.*

344. Chamæsiphon confervicola, *A. Br. in Rabenh. Alg.* no. 1726; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 148.

Long. 30–37 μ; lat. 3·2–3·5 μ.

Tanganyika.—On *Cladophora* sp., shores of lake, Niamkolo (1 Aug. 1904; no. 44). On *Chætomorpha Linum* floating in Kituta Bay (26 Aug. 1904; no. 79).

345. Chamæsiphon incrustans, *Grun. in Rabenh. Fl. Europ. Alg.* ii. (1865) p. 149.—Sphærogonium incrustans, *Rostaf. in Rospraw. Spraw. Posiedz. Akad. Umiej.* x. (1883) pp. 304–5, t. 5. figs. 1–7.

Nyasa.—On *Cladophora crispata*, Anchorage Bay (no. 11).

Victoria Nyanza.—On *Cladophora crispata*, Bukoba (17 Apr. 1905; no. 247).

Tanganyika.—On *Chætomorpha Linum*, Niamkolo Bay (3 Aug. 1904; no. 40).

Family CHROOCOCCACEÆ.

Subfam. Chroocysteæ.

Genus GLŒOCHÆTE, *Lagerh.*

346. Glœochæte Wittrockiana, *Lagerh. in Öfvers. K. Sv. Vet.-Akad. Förh.* (1883) no. 2, p. 39, t. 1. figs. 3, 4.—G. bicornis, *Kirchn. Nachtr. zu Algenfl. v. Württ.* 1888, p. 165. Schrammia barbata, *Dangeard, in Le Botaniste* (1889), p. 158, t. 7. figs. 12 *a–j*.

Diam. cell. 8·5–15 μ; long. set. 54–196 μ.

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

Subfam. Chroococceæ.

Genus APHANOTHECE, *Näg.*

347. Aphanothece microscopica, *Näg. Gatt. einz. Alg.* (1849) p. 59, t. 1 H.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904; no. 22).

Genus DACTYLOCOCCOPSIS, *Hansg.*

348. Dactylococcopsis africana, sp. n.

D. cellulis circ. 8–9 in familiis fasciculatim aggregatis, in medio decussatim conjunctis; cellulis elongatis et cylindricis, diametro 37–42-plo longi-

oribus, cum polis attenuatis et acutis; cytoplasmate homogeneo et pallide æruginoso.

Long. cell. 75–88 μ; lat. cell. 1·8–2·5 μ.

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

D. africana is distinguished from all other species of the genus by its stellate colonies of elongated cells, which are suddenly bent round each other in the middle after the manner of some forms of *Ankistrodesmus falcatus*, (Corda) Ralfs. In the length of its cells this species agrees with *D. acicularis*, Lemm. (in Ber. Deutsch. Bot. Ges. xviii. (1900) p. 309), but differs in the bent cells, forming star-shaped colonies, and in the absence of the bright refractive granules from the cytoplasm.

Genus MERISMOPEDIA, *Meyen*.

349. MERISMOPEDIA GLAUCA, *(Ehrenb.) Näg. Gatt. einz. Alg.* (1849) p. 55, t. 1 D. fig. 1.

Nyasa.—On shores and among *Utricularia*, Domira Bay (19 June, 1904; nos. 17 and 579).

Victoria Nyanza.—Among *Utricularia*, near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, near Baraka (24 Feb. 1905; no. 240).

350. MERISMOPEDIA PUNCTATA, *Meyen*, 1839; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 57.

Nyasa.—In swamp, Karonga (2 July, 1904; no. 34).

Victoria Nyanza.—Near Entebbe (1 May, 1905; no. 620).

Tanganyika.—In plankton, near Chamkaluki (15 Nov. 1904; no. 160).

351. MERISMOPEDIA ÆRUGINEA, *Bréb. in Kütz. Spec. Alg.* (1849) p. 472.

Tanganyika.—In plankton, Lofu (6 Oct. 1904; no. 130), and near Sumbu (13 Oct. 1904; no. 138).

352. MERISMOPEDIA ELEGANS, *A. Br. in Kütz. l. c.*; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 57.

Tanganyika.—In plankton, Vua Harbour (29 Oct. 1904; no. 150).

Var. REMOTA, var. n.

Var. cellulis ut in forma typica sed remotis, coloniis plus minusve subirregularibus.

Diam. colon. (cell. 32–128) 52–146 μ; diam. cell. 7–9 μ.

Tanganyika.—In plankton, near Baraka (24 Feb. 1905; no. 240).

The cells were similar in size and colour to those of *M. elegans*, but were more or less remote from each other in the enveloping jelly. The colonies were also more irregular than any I have previously observed of *M. elegans*. A few of the cells in each colony possessed a single dark granule, very probably of the nature of a gas-vacuole.

Genus TETRAPEDIA, *Reinsch.*

353. Tetrapedia Reinschiana, *Arch. in Grevillea*, i. (1872) p. 46, t. 3. figs. 11–13.

Nyasa.—On shore, Domira Bay (19 June, 1904; no. 17). In swamp, Karonga (2 July, 1904 ; no. 34).

354. Tetrapedia glaucescens, (*Wittr.*) *Boldt.*—Arthrodesmus? glaucescens, *Wittr. in Bih. K. Sv. Vet.-Ak. Handl.* (1872) no. 1, p. 55, t. 4. fig. 11.

Nyasa.—In scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 ; no. 577). Swampy lake margin, Domira Bay (19 June, 1904 ; no. 579).

Tanganyika.—In swamp, Kituta (23 Aug. 1904 ; n. 72).

Genus GOMPHOSPHÆRIA, *Kütz.*

355. Gomphosphæria aponina, *Kütz. Tab. Phyc.* i. t. 31. fig. 3 ; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 56.

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36). Among *Cladophora* on shores, Niamkolo (1 Aug. 1904 ; no. 44). In plankton, Vua Harbour (29 Oct. 1904; no. 150).

356. Gomphosphæria lacustris, *Chodat, in Bull. Herb. Boiss.* vi. (1898) pp. 180–182, cum fig. 1.

Nyasa.—In plankton, off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—In plankton, near Bukoba (21 April, 1905 ; no. 252).

Genus MICROCYSTIS, *Kütz.*

357. Microcystis æruginosa, *Kütz. Tab. Phyc.* i. t. 8.—Polycystis æruginosa, *Kütz.* Clathrocystis æruginosa, *Henfrey, in Journ. Micr. Sci.* (1856) p. 53, t. 4. figs. 28–36.

Nyasa.—In plankton, near Mtangula (22 June, 1904; no. 20), off Vahambwera Point (24 June, 1904 ; no. 24), and off Karonga (1 July, 1904 ; no. 30).

Victoria Nyanza.—In plankton, near Bukoba (April 1905 ; nos. 249, 250, and 252).

358. Microcystis viridis, (*A. Br.*) *Lemm. in Abh. Naturh. Ver. Bremen*, xvii. (1903) p. 342.—Polycystis viridis, *A. Br. in Rabenh. Alg.* no. 1415 ; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 53.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904 ; no. 9).

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905 ; no. 252).

359. Microcystis prasina, (*Wittr.*) *Lemm. in Arch. Botanik K. Sv. Vet.-Akad.* Bd. ii. (1904) no. 2, p. 146.—Polycystis prasina, *Wittr. in Wittr. & Nordst. Alg. Exsic.* 1879, no. 297.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 33).

360. Microcystis elabens, (*Bréb.*) *Kütz. Tab. Phyc.* i. t. 8 ; *Sp. Alg.* (1849) p. 210.

Nyasa.—In shore-pools, Nkata Bay (23 June, 1904 ; no. 22).

Tanganyika.—In plankton, off Niamkolo Island (29 July, 1904 ; no. 36) and near Niamkolo (7 Sept. 1904 ; no. 88).

361. Microcystis incerta, *Lemm. in Abh. Naturh. Ver. Bremen*, xvii. (1903) p. 342.

Tanganyika.—In swamp, Kituta (26 Aug. 1904 ; no. 80).

Victoria Nyanza.—In plankton, Bukoba (18 Apr. 1905 ; no. 249). In sheltered bay, near Entebbe (1 May, 1905 ; no. 620).

Genus APHANOCAPSA, *Näg.*

362. Aphanocapsa pulchra, (*Kütz.*) *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 49.

Tanganyika.—Dredged from a few fathoms, Kala (19 Nov. 1904 ; no. 171).

Genus CHROOCOCCUS, *Näg.*

363. Chroococcus minimus, (*Keissler*) *Lemm. in Arch. Bot. K. Sv. Vet.-Akad.* ii. (1904) no. 2, p. 102.—Ch. minutus *var.* minimus, *Keissler, in Verh. zool.-bot. Ges. Wien* (1901), p. 394, figs. 1, 2.

Nyasa.—In plankton, Anchorage Bay (13 June, 1904 ; no. 9) and Monkey Bay (17 June, 1904 ; no. 15).

364. Chroococcus Parallelopipedon, *Schmidle, in Engl. Bot. Jahrb.* xxx. (1902) p. 242, t. 5. fig. 7.

Nyasa.—Scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 ; no. 577).

365. Chroococcus helveticus, *Näg. Gatt. einz. Alg.* (1849) p. 46, t. 1 A. fig. 3.

Tanganyika.—In swamp, Toa (10 Jan. 1905 ; no. 208).

366. Chroococcus pallidus, *Näg. l. c.* t. 1 A. fig. 2.

Victoria Nyanza.—In plankton, Bukoba (21 Apr. 1905 ; no. 252).

367. Chroococcus turgidus, (*Kütz.*) *Näg. l. c.* p. 46 ; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 32.

Nyasa.—In swamp, Karonga (2 July, 1904 ; no. 33). In scrapings from bottom of s.s. 'Guendolen' at anchor S. end of lake (15 June, 1904 ; no. 577).

Tanganyika.—In plankton, Baraka (24 Feb. 1905 ; no. 240).

Class **PERIDINIEÆ.**

Order PERIDINIALES.

Family **GLENODINIACEÆ.**

Genus GLENODINIUM, *Ehrenb.*

368. GLENODINIUM PULVISCULUS, (*Ehrenb.*) *Stein, Organ. Infus.* iii. Hälfte 2, t. 2. figs. 23–26.

Tanganyika.—In plankton, near Mbete (28 Sept. 1904 ; no. 105), Komba Bay (11 Oct. 1904 ; no. 135), and near Kala (19 Nov. 1904 ; no. 170).

Family **PERIDINIACEÆ.**

Genus PERIDINIUM, *Ehrenb.*

369. PERIDINIUM AFRICANUM, *Lemm.*, sp. n. (Pl. **9**. fig. 1.)

P. pæna tam longum quam latum, 24–30 μ longum et 23–27 μ latum ; corpore in partibus inæqualibus duabus a fossa transversa diviso, parte apicali majore; fossa transversa pæne circulari; fossa longitudinali margine posteriore extensa, parte posteriore multe dilatata; membrana glabra, striis intercalaribus delicatissimis.

Epivalva (Pl. **9**. fig. 1, *d*) conica; tabula rhomboidea juxta apicem extensa; tabulis æquatoriis 7; tabulis apicalibus ventralibus hexagonis, tabulis apicalibus dorsalibus pentagonis, tabula dorsali quadrata pro tabulis apicalibus dorsalibus disposita. *Hypovalva* (fig. 1, *c*) rotundo-conica, margine posteriore concavo ; tabulis æquatoriis 5; tabulis antapicalibus 2, una minore et altera multe majore; margine ventrali tabulæ antapicalis spina robusta hyalino ornato.

Cystis cordiformis, 20·5 μ longis et 22 μ latis; membrana crassa, glabra et hyalina (fig. 1, *e*).

Nyasa.—In plankton, Anchorage Bay (June, 1904 ; nos. 5, 9, and 10) and Monkey Bay (June, 1904 ; nos. 15 and 16).

Tanganyika.—In plankton, near Kala (19 Nov. 1904 ; no. 170).

370. PERIDINIUM BEROLINENSE, *Lemm. in Ber. Deutsch. Bot. Ges.* xviii. (1900) p. 308.

Var. APICULATUM, *Lemm.*, var. n. (Pl. **9**. fig. 3.)

P. rhomboideum, 41–42 μ longum et 40–41 μ latum; corpore ut in viso aspectu cingulato subcirculari, margine posteriore concavo et spinis brevibus inæqualibus duobus ornato, in partibus æqualibus duabus a fossa transversa diviso. Fossa transversa (Pl. **9**. fig. 3, *b*) spiraliter disposita. Fossa longitudinali margine posteriore extensa sed a parte apicali exclusa; margine sinistro fossæ longitudinalis in alam compressam extenso, margine alæ cum papillis minutissimis numerosis (fig. 3, *c*).

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135) and near Kala (19 Nov. 1904; no. 170).

This variety differs from the typical form in the presence of the spines at the posterior margin, in the conical apical part of the cell, and in the absence of the small papillæ which cover the sutures between the plates in the typical form.

Genus PERIDINIOPSIS, *Lemm.*

371. PERIDINIOPSIS CUNNINGTONII, *Lemm.*, sp. n. (Pl. **9**. fig. 2.)

P. paullo longius quam latius, 31·5–38 μ longum et 27–31·5 μ latum, margine posteriore truncato; corpore in partibus inæqualibus duabus a fossa transversa diviso, parte apicali majori; fossa transversa (Pl. **9**. fig. 2, *a*) conspicue spiraliter disposita; fossa longitudinali in partem apicalem extensa et margine posteriore versus valde dilatato. Membrana delicatissime reticulata; striis intercalaribus delicatis.

Epivalva (Pl. **9**. fig. 2, *d*) conica, cum tabulis æquatoriis 6; tabula rhomboidea apicem extensa; tabulis apicalibus 4, ventralibus 2 et dorsalibus 2. *Hypovalva* (Pl. **9**. fig. 2, *e*) truncato-conica, cum tabulis æquatoriis 5, ventralibus 2 et lateralibus 2 cum spina robusta brevi singula; tabulis antapicalibus 2, cum spina singula in tabula unaquaque.

Tanganyika.—In plankton, Komba Bay (11 Oct. 1904; no. 135), and near Kala (19 Nov. 1904; no. 170).

The body of this species resembles that of *Peridinium quadridens*, Stein, but differs in the number and arrangement of the plates and in the number of the spines.

This is the second described species of the genus *Peridiniopsis*. *P. Borgei*, Lemm. (in Arch. Bot. K. Sv. Vet.-Akad., Bd. ii. (1904) no. 2, p. 134, t. 1. figs. 1–5), has three antapical plates and no spines, whereas *P. Cunningtonii* has two antapical plates and six conspicuous spines. In both species the epivalve possesses six equatorial plates.

Genus CERATIUM, *Schrank.*

372. CERATIUM HIRUNDINELLA, *O. F. Müll.*

Small forms with only two antapical horns: length 136–148 μ; breadth 50–54 μ; length of apical horn about 50–60 μ; length of 1st antapical horn about 30–44 μ; length of 2nd antapical horn about 10–12 μ. (Pl. **9**. fig. 4.)

Victoria Nyanza.—In plankton, near Bukoba (21 Apr. 1905; no. 252).

The species was very scarce, and the few specimens observed differed very much from any others which have come under my notice. They were small, with short horns, and the wall was strongly reticulated. The apical horn was short with a broad base and slightly curved, and only two antapical horns were present. The first antapical horn was attenuated from a broad base, apiculate at the extremity and turned inwards. The second antapical

horn was very short, acute, and slightly variable in its position relative to the first one, but in every specimen seen it was situated much nearer to the first antapical horn than has been described or figured for any European specimen. (*Vide* Lemmermann, in Arch. Bot. K. Sv. Vet.-Akad. ii. (1904) no. 2, t. 2. figs. 1–49; W. & G. S. West, in Trans. Roy. Soc. Edinb. xli. part III. (1905) p. 494, fig. 1 A–D; in Trans. Roy. Irish Acad. xxxiii. sect. B, part II. (1906) p. 94, figs. 1–9.)

IV. GENERAL SUMMARY OF THE INVESTIGATION.

1. The Algæ observed in Dr. Cunnington's collections can be summarized as follows:—

	Genera.	Species.	Varieties and Forms.
CHLOROPHYCEÆ.			
Œdogoniales	2	6	1
Chætophorales	4	4	
Cladophorales	2	7	
Conjugatæ	17	122	12
Protococcoideæ	27	48	17
HETEROKONTÆ.			
Confervales	1	1	
BACILLARIEÆ.			
Centricæ	3	7	3
Pennatæ	18	86	15
MYXOPHYCEÆ.			
Hormogoneæ	17	62	2
Coccogoneæ	10	24	1
PERIDINIEÆ.			
Peridiniales	4	5	
Total	105	372	51

These results have added greatly to our knowledge of the geographical distribution of freshwater Algæ in tropical Africa.

2. Of the above, 1 genus, 36 species, and 18 varieties and forms are described as new.

3. The plankton collected in Nyasa in June 1904 contained 48 species of Algæ, which are chiefly interesting in comparison with Dr. Fülleborn's more extensive collections from 1898 to 1900.

4. The plankton from Victoria Nyanza was collected in April 1905 and contained 58 species. Again, the chief interest of these collections lies in a

comparison with the material collected by Dr. Stuhlmann in October 1892. The Bacillarieæ and Myxophyceæ are relatively few in number, and the phytoplankton is essentially Chlorophyceous, with all the features of a Desmid-plankton.

5. The phytoplankton of Tanganyika is much richer in number of species than that of Nyasa or Victoria Nyanza. It contained 85 species, of which 61 (72 per cent.) *occurred in this lake alone.* The Chlorophyceæ were relatively few both as regards species and individuals, but the Bacillarieæ and Myxophyceæ were both represented by more than the usual proportion of species, and occurred at certain times in prodigious quantities. The Protococcoideæ and Bacillarieæ were especially evident during November, after which month there was a general diminution of the Algæ accompanied by a great development of *Nauplius* larvæ. Ten species and one variety of this phytoplankton were new.

Several of the species observed in the phytoplankton of this lake are usually marine or brackish in habit, and others more nearly approach marine species than freshwater ones. *Nitzschia Tryblionella*, Hantzsch, var. *littoralis*, (Grun.) Van Heurck, *Surirella striatula*, Turp., and *Chodatella subsalsa*, Lemm., are marine or brackish-water species. *Navicula distincta*, sp. n., and *Surirella Tanganyikæ*, sp. n., more nearly approach marine forms than freshwater ones, and *Oscillatoria Tanganyikæ*, sp. n., is much nearer the marine *Oscillatoria subuliformis*, Kütz., than any other described species. *Plectonema Wollei*, Farlow, is another curious Alga in the plankton: certainly a freshwater species, but one which only differs from the marine *Lyngbya majuscula*, Harvey, in the scarce development of false branches—a character which may be due to change of environment. The occurrence of no less than three species of *Nodularia*, a genus which is typically of brackish habit, in the immediate vicinity of Tanganyika is also a noteworthy fact.

The Alga-flora of Tanganyika differs very much from that of Nyasa or Victoria Nyanza, but its peculiarities are all of them such as could be accounted for by the prolonged isolation of the lake. The definite outlet by the River Lukuga into the Congo system is relatively recent, having been established since the formation of the volcanic cones to the north of Lake Kivu. The damming up of the northern end of the Lake Kivu region added a large drainage-area to the Tanganyika lake-basin, and marks the close of the period of isolation. There is every reason to consider the presence of certain brackish-water Algæ, and others with marine affinities, as evidence that during the period of prolonged isolation the water became increasingly saline. Our knowledge of the modifications which some Algæ undergo owing to change of environment is in support of the view that *those Algæ of Tanganyika exhibiting marine affinities may have been produced by a gradual increase in the salinity of the water over an extended period of time. The relatively small proportion of Chlorophyceæ in the plankton, and the large proportion of Bacil-*

lariea and Myxophyceæ, is also an indication that the water of the lake was at one time much more saline than it is at present.

Collections made within a few days of one another from different parts of Tanganyika differ so much, even in their dominant constituents, that it is not at all improbable that some of these plankton-organisms may occur in large shoals of more or less limited extent. From available evidence it is not possible, however, to make a definite statement on this point, as collections were not actually made in different parts of the lake at the same time; but the dominance of *Anabæna Flos-aquæ* var. *circularis* in some collections, and of *Nitzschia nyassensis* and *Synedra Acus* in others obtained very shortly afterwards from other parts, indicates that the plankton of the lake is by no means of a uniform character. The Nyasa plankton collections also furnish evidence of a similar absence of uniformity, but, owing to their less comprehensive nature, to a much less marked degree.

In large bodies of fresh water, such as these Central African lakes, it would appear that a single sample of plankton obtained in a stated locality must not be regarded as representative of the plankton of the entire lake.

EXPLANATION OF THE PLATES.

Plate 2.

Photomicrographs of plankton from Lake Nyasa.

Figs. 1–16 × 100; figs. 17–20 × 150.

Figs. 1 & 2. Varieties of *Pediastrum simplex*; 3. *Stephanodiscus Astræa*; 4. *Melosira granulata*, var. *angustissima*; 5. *Synedra Acus*; 6 & 7. *Melosira nyassensis*; 8. *Anabæna Flos-aquæ*, forma; 9. *Surirella bifrons*, var. *tumida*.

10. *Closteriopsis longissima*; 11 & 12. *Surirella Nyassæ*, with numerous attached *Vorticellæ* or similar Infusoria.

13 & 14. *Melosira granulata*, var. *angustissima*; 15 & 16. *Anabæna Flos-aquæ*, forma.

17 & 18. *Pediastrum simplex*, var. *clathratum*; 19. *Melosira granulata*, var. *angustissima*; 20. *Anabæna Flos-aquæ*, forma.

Plate 3.

Photomicrographs of plankton from Victoria Nyanza.

All × 100.

Figs. 1. *Staurastrum cuspidatum*; 2. *Surirella Malombæ*; 3 & 4. *Surirella Füllebornii*, var. *elliptica*; 5. *Melosira nyassensis*; 6 & 7. Masses of partially decomposed organic matter which form a feature of the plankton examined from this lake; 7 is probably the excreta of some animal.

8–10. *Staurastrum limneticum*; 11. *S. leptocladum*, forma *africana*; 12. *Sphinctosiphon polymorphus*, young colony; 13 & 14. *Surirella Malombæ*; 15. *Staurastrum tohopekaligense*.

16. *Pediastrum simplex*, var. *clathratum*; 17. *Surirella*, sp.?; 18. *Lyngbya circumcretum*; 19. Floating and partly decomposed organic matter.

Figs. 20. *Staurastrum limneticum*; 21. *S. tohopekaligense*; 22 & 23. *Surirella Malombæ*; 24 & 25. *Surirella Füllebornii*, var.; 26. *Melosira nyassensis*; 27. Mass of decomposing organic matter, probably excreta; 28. Mass of decaying organic matter, largely derived from Blue-green Algæ.

Note.—The quantity of decaying organic matter in the plankton of Victoria Nyanza is rendered very obvious by the numerous dark, ill-defined patches in the photographs.

Plate 4.

Photomicrographs of plankton from Tanganyika.

Figs. 1–13 × 100; figs. 14–17 × 200.

Figs. 1–3. *Sphærocystis Schroeteri*; 4 & 5. *Hyalotheca mucosa*. Figs. 1–5 represent plankton from the River Lofu near its entrance to Tanganyika.

6. *Oocystis lacustris*; 7 & 8. *Nitzschia nyassensis*. (This Diatom occurred in countless myriads in plankton collections from certain parts of Tanganyika. It is of great length and very slender, much resembling the elongated varieties of *Synedra Acus*, to which plant it should possibly be referred.)

The delicate curved lines in the photograph represent one of the minute plankton-species of the genus *Lyngbya*.

9. *Nitzschia nyassensis*; 10 & 11. *Anabæna Flos-aquæ*, var. *circularis*; 12 & 13. *Glenodinium Pulvisculus*.

The dominating feature of this plankton is the short and much coiled variety of *Anabæna Flos-aquæ*. In this respect the plankton is remarkably similar to certain collections from Nyasa (*vide* Pl. **2**. figs. 15 & 16).

14 & 15. *Anabæna Flos-aquæ*, var. *circularis*; 15 shows very clearly the terminal heterocysts. 16 & 17. *Glenodinium Pulvisculus*.

Plate 5.

Figs. 1–2. *Spirogyra æquinoctialis*, sp. n. × 500. 1, single vegetative cell showing chloroplasts; 2, male and female gametangia, with zygospore in greatly swollen female gametangium.

3–4. *Debarya africana*, sp. n. × 500. 3, zygospore enclosed within the gametangia and conjugating-tube; 4, junction of vegetative cell (*c.v.*) and gametangium (*g.*), showing thickened walls of latter with curious pit-like structure in the end-wall.

Fig. 5. *Pediastrum Tetras*, (Ehrenb.) Ralfs, var. *longicorne*, Racib. × 520.

6. *P. Tetras*, (Ehrenb.) Ralfs. × 520. Curious cœnobium of three cells.

7. *Crucigenia tetracantha*, sp. n. × 500.

Figs. 8–9. *Cœlastrum compositum*, sp. n. × 520. 8, small cœnobium of eight groups of three cells each; 9, much larger cœnobium.

Fig. 10. *Palmophyllum foliaceum*, sp. n. *th.*, thallus, × 100; *c.*, a few of the minute green cells, × 500.

Figs. 11–13. *Sphinctosiphon polymorphus*, gen. et sp. n. 11, young colonies, × 100; 12, older and more elongated colony showing a few slight constrictions, × 100; 13, small portion of colony, × 520. 11 & 12 are only drawn in outline to show the hollow thallus.

14–17. *Chodatella subsalsa*, Lemm. × 500. 15, cell containing two daughter-cells; 16 with four, and 17 with eight undeveloped gonidia (autospores).

Fig. 18. *Ankistrodesmus nitzschioides*, sp. n. × 500.

19. *Pediastrum simplex*, Meyen. × 500. Small 4-celled cœnobium in which one cell has been aborted.

Fig. 20. *Pediastrum simplex*, Meyen. × 500. Curious abnormal form in which the cœnobium is not strictly plate-like. Some of the cells, such as *a*, are like those of typical *P. simplex*; *b* is similar to the peripheral cells of *P. Boryanum*, and *c* like those of *P. Kawraiskyi*, Schmidle; *g*., resting gonidium (aplanospore).

21. *P. simplex*, Meyen, var *clathratum*, forma *radians*. × 500. Abnormal condition with one cell (*a*) of the ring deformed.

22. *P. Boryanum*, (Turp.) Menegh., var. *rugulosum*, var. n. × 500. Five cells (2 peripheral and 3 central) from a large cœnobium.

Plate 6.

Fig. 1. *Pleurotænium caldense*, Nordst., forma *africanum*. × 520.
2. *Closterium nematodes*, Josh., var. *tumidum*, var. n. × 520.
3. *Penium australe*, Racib., forma *brevius*. × 520.
4. „ „ forma *crassius*. × 520.
5. *Staurastrum pilosum*, (Näg.) Arch., var. *minimum*, var. n. × 520.
6. „ *quadrangulare*, Bréb., var. *attenuatum*, Nordst., forma. × 520.
7. „ *Cunningtonii*, sp. n. × 520.
8. „ *anatinum*, Cooke & Wills, var. *subglabrum*, var. n. × 520.
9. „ *monticulosum*, Bréb., var. *bidens*, var. n. × 520.
10. „ *gracile*, Ralfs, var. *Nyansæ*, var. n. × 520.
11. „ „ var. *protractum*, var. n. × 500.
12. „ *leptocladum*, Nordst., forma *africanum*. × 500.
13. *Arthrodesmus Incus*, (Bréb.) Hass., var. *Ralfsii*, W. & G. S. West, forma. × 520.

Plate 7.

Figs. 1–2. *Micrasterias Cunningtonii*, sp. n. × 520.
Fig. 3. *Euastrum truncatiforme*, sp. n. × 520.
Figs. 4–5. „ *pseudopectinatum*, Schmidle, forma. × 520.
Fig. 6. *Cosmarium galeritum*, Nordst., var. *retusum*, var. n. × 520.
7. „ *Cunningtonii*, sp. n. × 520.
8. „ *decachondrum*, Roy & Biss., var. *ornatum*, var. n. × 520.
9. „ *lacunatum*, sp. n. × 520. The minute punctulations which surround the granules are not shown in the figure.
10. „ *globosum*, Buln., var. *Wollei*, W. & G. S. West, forma *major*. × 520.
11. „ *Pseudobroomei*, Wolle, var. *compressum*, var. n. × 520.

Plate 8.

Fig. 1. *Fragilaria æthiopica*, sp. n. × 1000.
2. *Navicula distincta*, sp. n. × 500.
3. *Synedra Nyansæ*, sp. n. × 520.
4. „ *Cunningtonii*, sp. n. × 250.
5. *Surirella plana*, sp. n. × 500.
6. „ *Tanganyikæ*, sp. n. × 500.
7. „ *obtusiuscula*, sp. n. × 500.
8. *Cymatopleura Nyansæ*, sp. n. × 520.
9. *Cocconema grossestriata*, (O. Müll.) nob., var. *Tanganyikæ*, var. n. × 500.
10. *Gyrosigma nodiferum*, (Grun.) nob. × 500.
11. *Navicula Tanganyikæ*, sp. n. × 500.
12. *Schizostauron Crucicula*, Grun. × 520.
13. *Gomphonema africanum*, sp. n. × 520.

PLATE 9.

Fig. 1. *Peridinium africanum*, Lemm., sp. n. × 750. *a*, ventral view; *b*, dorsal view; *c*, hypovalve; *d*, epivalve; *e*, cyst. (After drawings by Lemmermann.)

2. *Peridiniopsis Cunningtonii*, Lemm., sp. n. × 750. *a*, ventral view; *b*, dorsal view; *c*, lateral view; *d*, epivalve; *e*, hypovalve. (After drawings by Lemmermann.)

3. *Peridinium berolinense*, Lemm., var. *apiculatum*, Lemm., var. n. × 750. *a*, dorsal view; *b*, ventral view; *c*, lateral view. (After drawings by Lemmermann.)

4. *Ceratium Hirundinella*, O. F. Müll. × 500. Small reduced form from Victoria Nyanza. The markings are only shown on a small portion of the cell.

5. *Spirulina Princeps*, W. & G. S. West. × 520.

6. „ *laxissima*, sp. n. × 1000.

7. *Lyngbya circumcretum*, sp. n. × 520. *a*, *b*, and *c*, three specimens to show the coiling of the filaments.

8. *Anabæna* sp. × 520. Consult page 170, no. 290.

9. *Oscillatoria Tanganyikæ*, sp. n. × 500. *a*, *b*, and *c*, apices of three filaments; *d*, middle part of filament. The large granules are probably gas-vacuoles.

PLATE 10.

Fig. 1. *Anabæna Flos-aquæ*, Bréb. forma. × 520.

2. „ „ var. *circularis*, var. n. × 520. *a–d* show normal coiling, the short filaments being terminated at each end by a heterocyst; *e*, a straight filament.

3. *Anabæna Tanganyikæ*, sp. n. × 520. *d*, filament with spore (*sp.*).

4. *Anabæna* sp. × 520. Consult page 171, no. 294.

5. *Glœotrichia longiarticulata*, sp. n. *a*, floating colony, × 10; *b–d*, bases of trichomes; *e* and *f*, spores. *b–f*, × 520.

6. *Rivularia globiceps*, sp. n. *a*, colonies attached to floating fragment of leaf, natural size; *b–d*, bases of trichomes. × 520.

7. *Calothrix cartilaginea*, sp. n. × 500. *a–d*, trichomes in different stages; *e*, middle portion of old trichome with well-marked sheath; *f*, hormogone.

8. *Calothrix brevissima*, sp. n. *a–e*, group of complete filaments, × 500; *d* and *e* each possess two basal heterocysts.

ADDENDA.

DESMIDIACEÆ.

373. PENIUM LAGENARIOIDES, *Roy, in J. P. Bissett, 'Desm. Windermere,' Journ. Roy. Micr. Soc.* (1884) p. 197, t. 5. fig. 6.

Var. SYDNEYENSE, *Racib. in Rospraw. Wydz. matem.-przyr. Akad. Umiej. Krakow,* xxii. (1892) p. 368, t. 6. fig. 3.

Long. 74 μ; lat. 29 μ; lat. constrict. 26 μ; lat. apic. 14 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

374. Cosmarium zonarium, *W. & G. S. West, in Trans. Linn. Soc.* ser. 2, *Bot.* v. (1895) p. 71, t. 8. fig. 13.

Long. 74 μ; lat. 49 μ; lat. isthm. 45 μ.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

This species has only previously been recorded from Madagascar.

375. Cosmarium Subcucumis, *Schmidle, in Ber. Naturf. Ges. Freiberg i. B.* vii. Heft 1 (1893), p. 98, t. 4. figs. 20–22.

Long. 80 μ; lat. 47 μ; lat. isthm. 21 μ.

Victoria Nyanza.—In swamp, Bukoba (20 Apr. 1905; no. 251).

PROTOCOCCACEÆ (AUTOSPORACEÆ).

376. Sorastrum spinulosum, *Näg. Gatt. einzell. Alg.* (1849) p. 99, t. 5 d.

Tanganyika.—In swamp, Kituta (23 Aug. 1904; no. 72).

SCYTONEMACEÆ.

377. Scytonema coactile, *Montagne, in Kütz. Sp. Alg.* (1849) p. 305; *Rabenh. Fl. Europ. Alg.* ii. (1865) p. 280; *Born. & Flah in Ann. Sci. Nat.*, sér. 7, *Bot.* v. (1887) p. 90.

Crass. fil. 16·5–20 μ; crass. trich. 11–12 μ; long. heterocyst. 14·5–20 μ, lat. 10–11·5 μ.

Sporæ quadratæ, angulis levissime rotundatis; episporio glabro; long. et lat. 14 μ.

Nyasa.—In swamp, Karonga (2 July, 1904; nos. 33 and 34).

The filaments and pseudo-rami were elongated and flexuose. The strong hyaline sheaths, which were turning yellow or yellow-brown in the older portions, were firm and slightly lamellose. The cells were subquadrate, sometimes a little longer than the diameter, of a bright blue-green colour, and often contained a few large granules of much deeper colour.

Some filaments were noticed with mature spores. They were seriate, as many as 40 occurring in a chain, and in form were quadrate with slightly rounded angles. Each spore had arisen from a single vegetative cell and possessed a smooth straw-coloured epispore. Borzì (in N. Giornale Bot. Ital. xi. 1879, p. 368) has described the occurrence of globose or ellipsoid spores in this genus, but those observed in *S. coactile* were all quadrate and reminded one very forcibly of the seriate spores of species of *Hapalosiphon.*

CHROOCOCCACEÆ.

378. Asterocystis africana, sp. n.

Plantæ minutæ et epiphyticæ; filis brevibus, vaginatis, subdichotome ramosis, ramis late patentibus, e serie singula cellularum formatis; vaginis latis et hyalinis; cellulis oblongo-quadratis vel oblongis, diametro usque ad

duplo longioribus, polis subrotundatis; cytoplasmate læte æruginoso et granuloso (fere ut in *Chroococco turgido*).

Long. cell. 5·5–10 μ; lat. cell. 4·5–5·5 μ; crass. vag. 11–15 μ (usque ad 27 μ).

Tanganyika.—Epiphytic on *Chætomorpha Linum*, floating in Kituta Bay (26 Aug. 1904; no. 79).

This plant belongs unquestionably to the Chroococcaceæ, the cells having very much the same structure as those of *Chroococcus*. It would fall naturally into Hansgirg's genus *Chroodactylon* (Ber. Deutsch. Bot. Ges. i. (1885) t. 3), but for the fact that Hansgirg has since placed both *Asterocystis*, Gobi (1879), and his own genus *Chroodactylon* (1885) as sections of "*Allogonium*, Kütz." (*vide* Hedwigia (1887), Heft 1). Although Hansgirg was in error in reviving "*Allogonium*," a name given by Kützing to a number of Algæ of widely different affinities and all of which are now placed in other genera, yet he was evidently of the opinion that *Asterocystis* and *Chroodactylon* were scarcely distinct. It is for this reason that I have placed the African plant as a species of the former genus. Schmitz (in Engl. Natür. Pflanzenfam. 1 Teil, Abt. 2, p. 314) places *Asterocystis* in the Bangiaceæ, but the species observed from Tanganyika is a typical Blue-green Alga.

The colonies of *Asterocystis africana* reach a diameter across the spreading branches of about 360 μ. The gelatinous sheath at the base of the primary filament is somewhat expanded and is firmly attached to the wall of the *Chætomorpha*, in which it makes a pit-like depression often 14 μ in depth.

NAVICULACEÆ.

379. Navicula serians, *Bréb. in Kütz. Bacill.* (1844) p. 92, t. 30. fig. 23; *W. Sm. Brit. Diat.* t. 16. fig. 130.

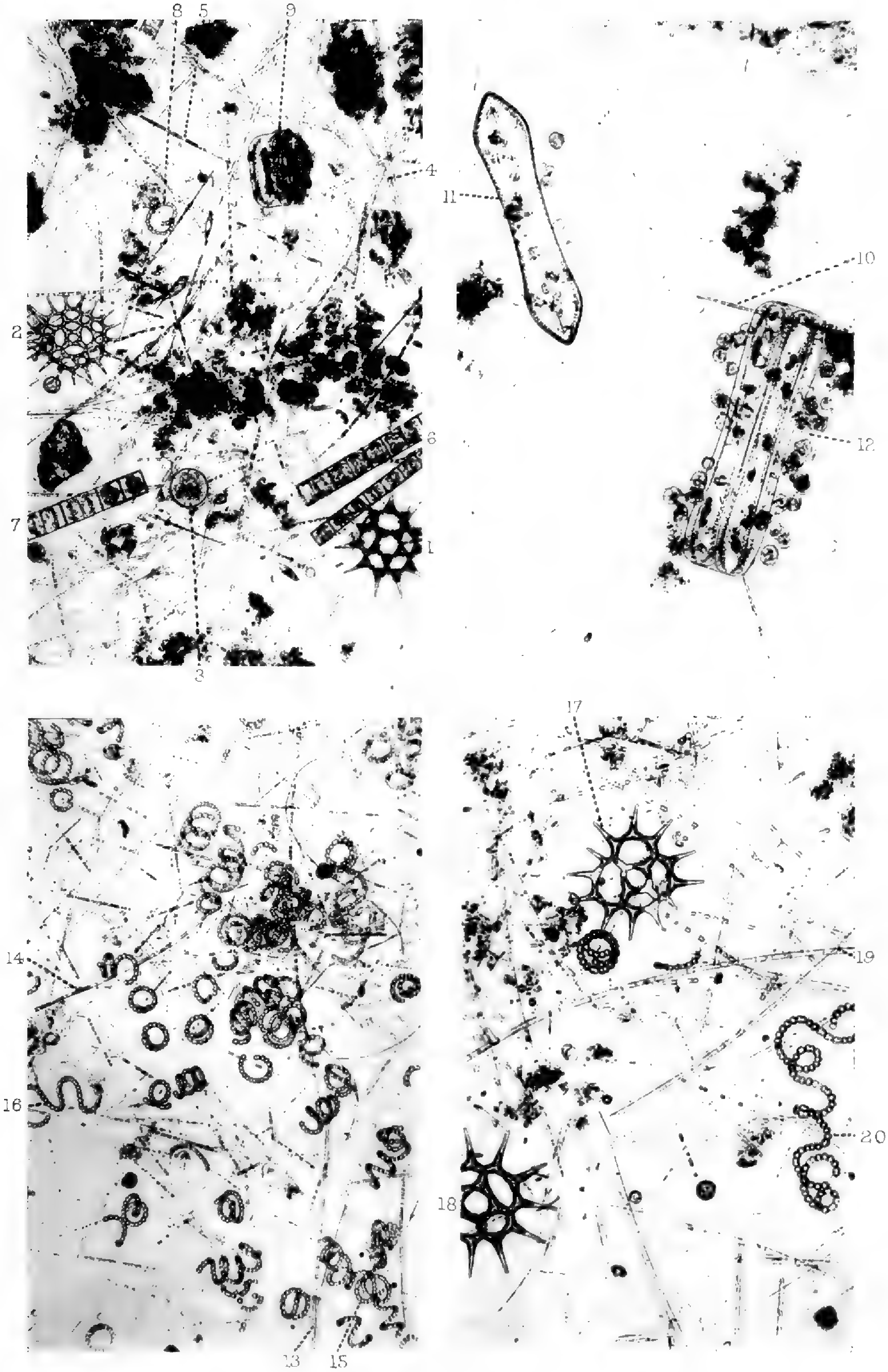
Nyasa.—In scrapings from bottom of s.s. 'Guendolen' at S. end of lake (15 June, 1904; no. 577).

GOMPHONEMACEÆ.

380. Rhoicosphenia curvata, (*Kütz.*) *Grun. in Abh. zool.-bot. Ges. Wien*, x. (1860) p. 511; *Van Heurck, Synops. Diat. Belg.* t. 26. figs. 1, 2, 3.

Tanganyika.—On the bottom of Dr. Cunnington's dau (24 Jan. 1905; no. 217).

The University, Birmingham,
19th March, 1907.



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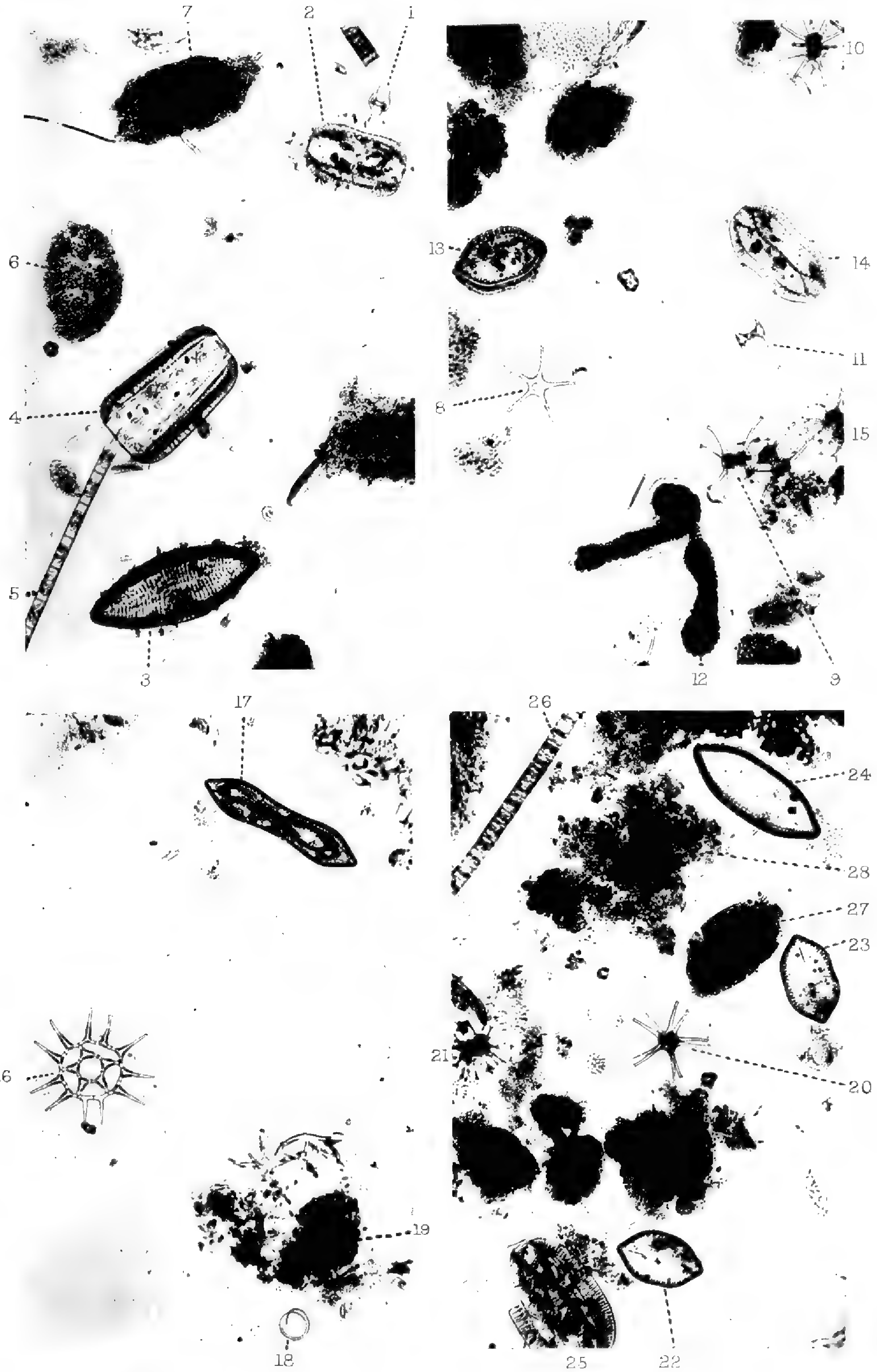

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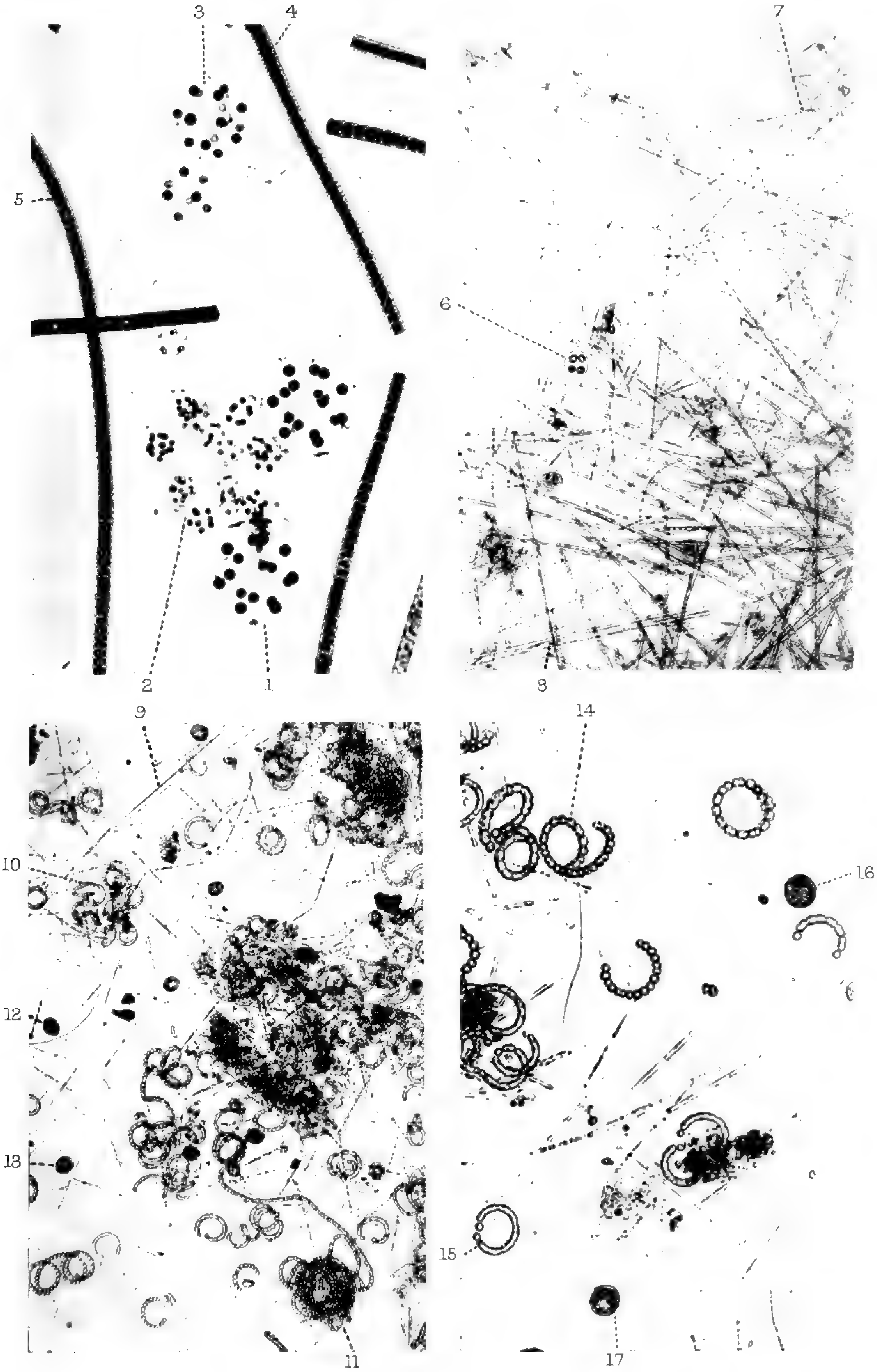

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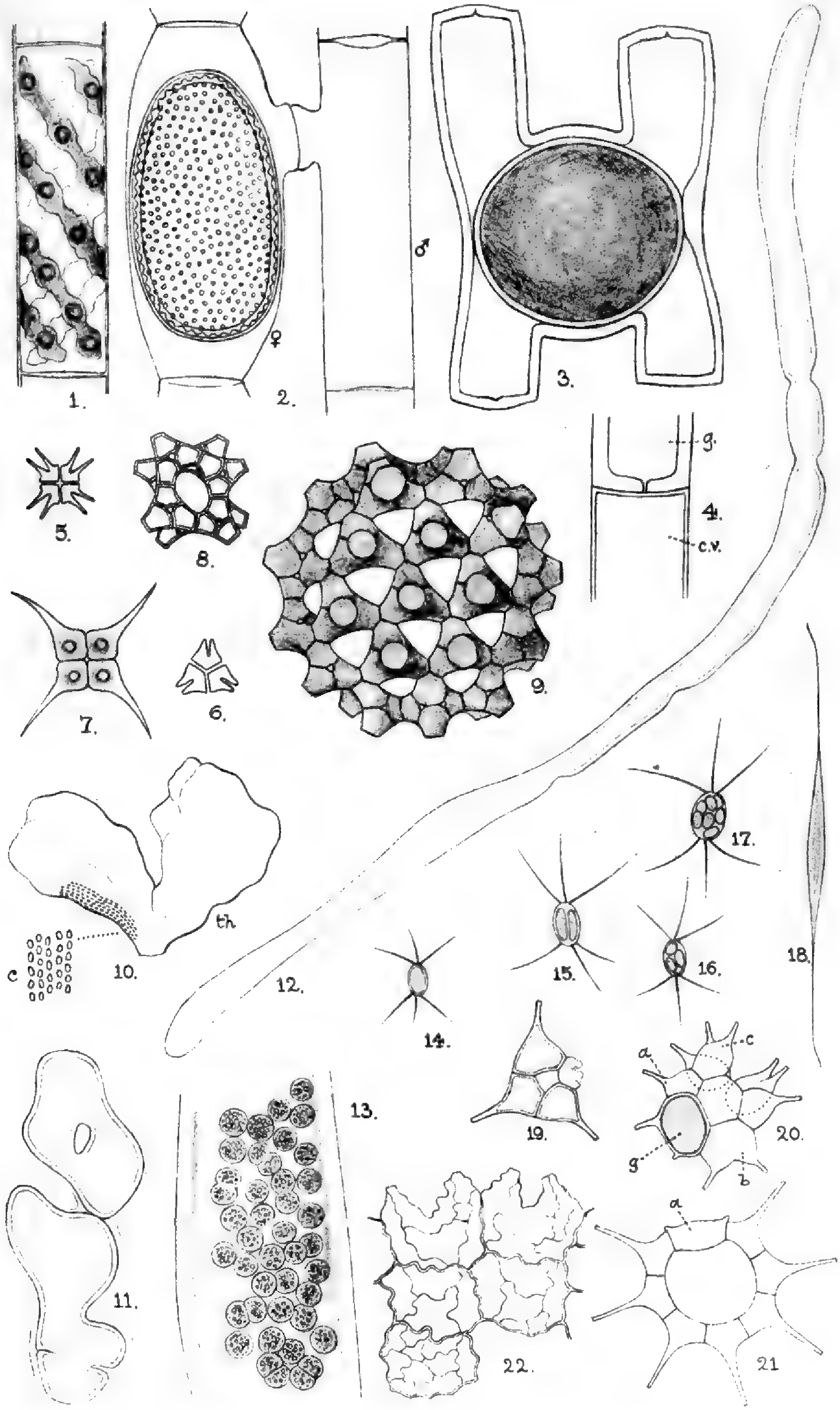

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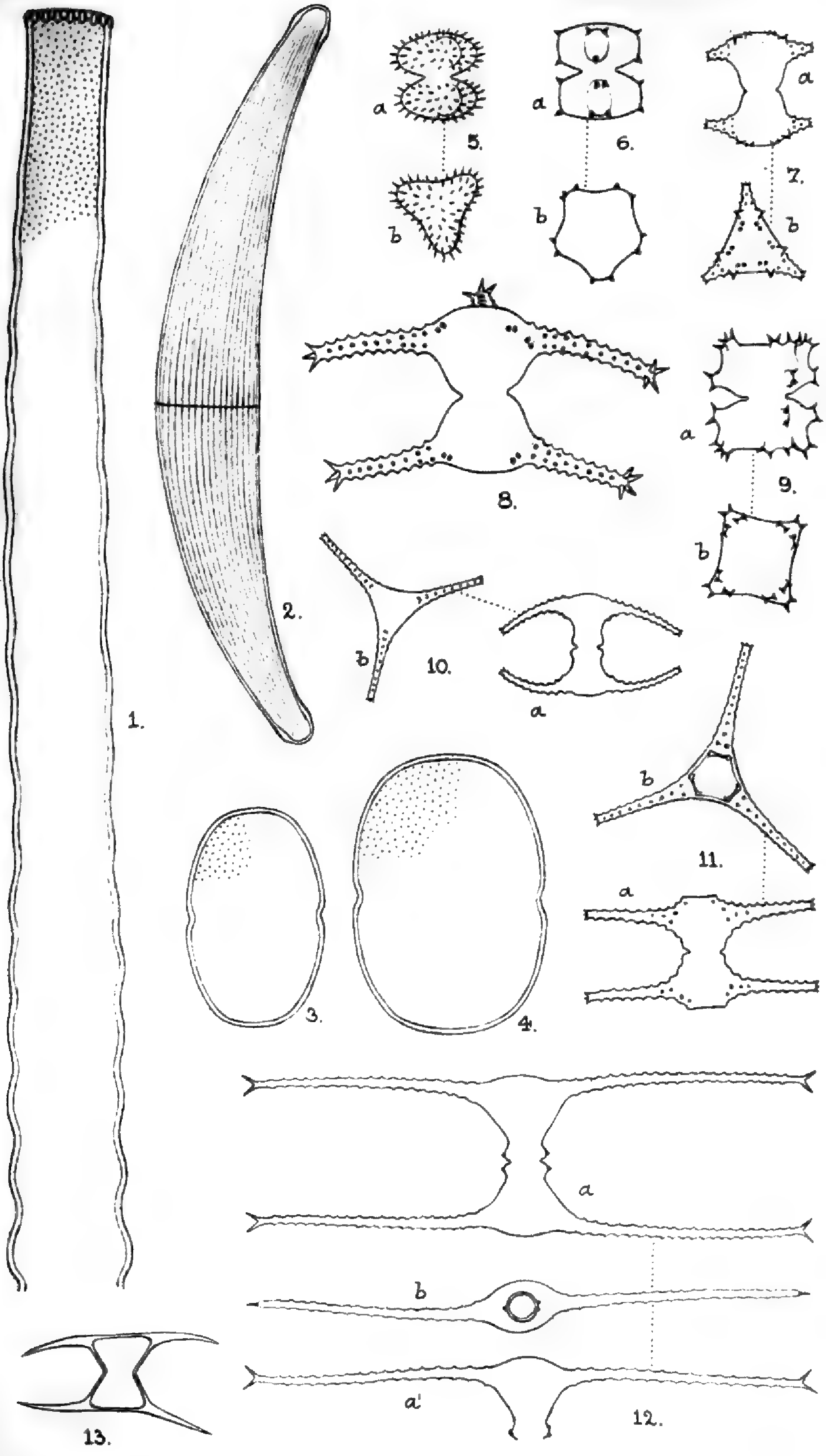

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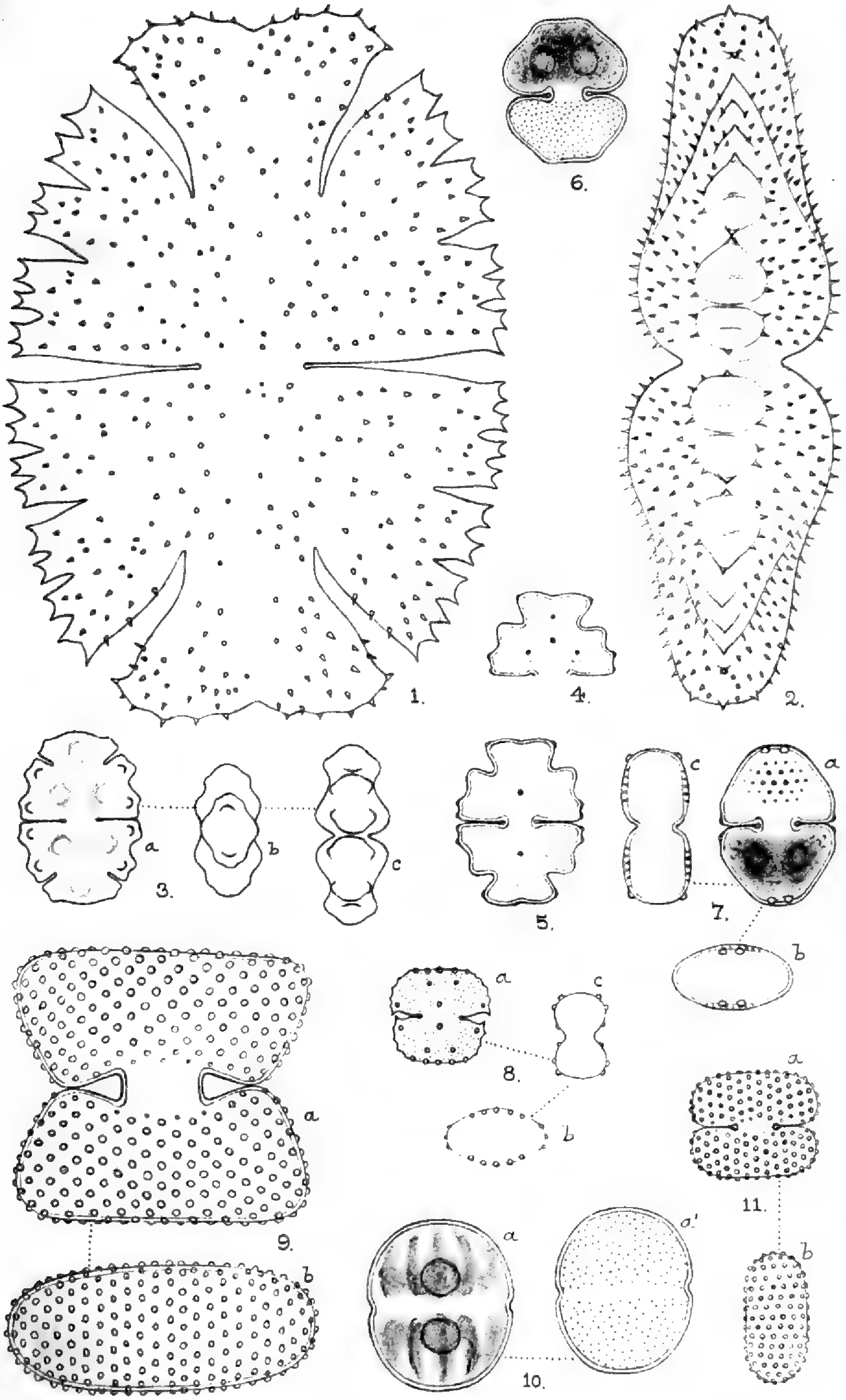

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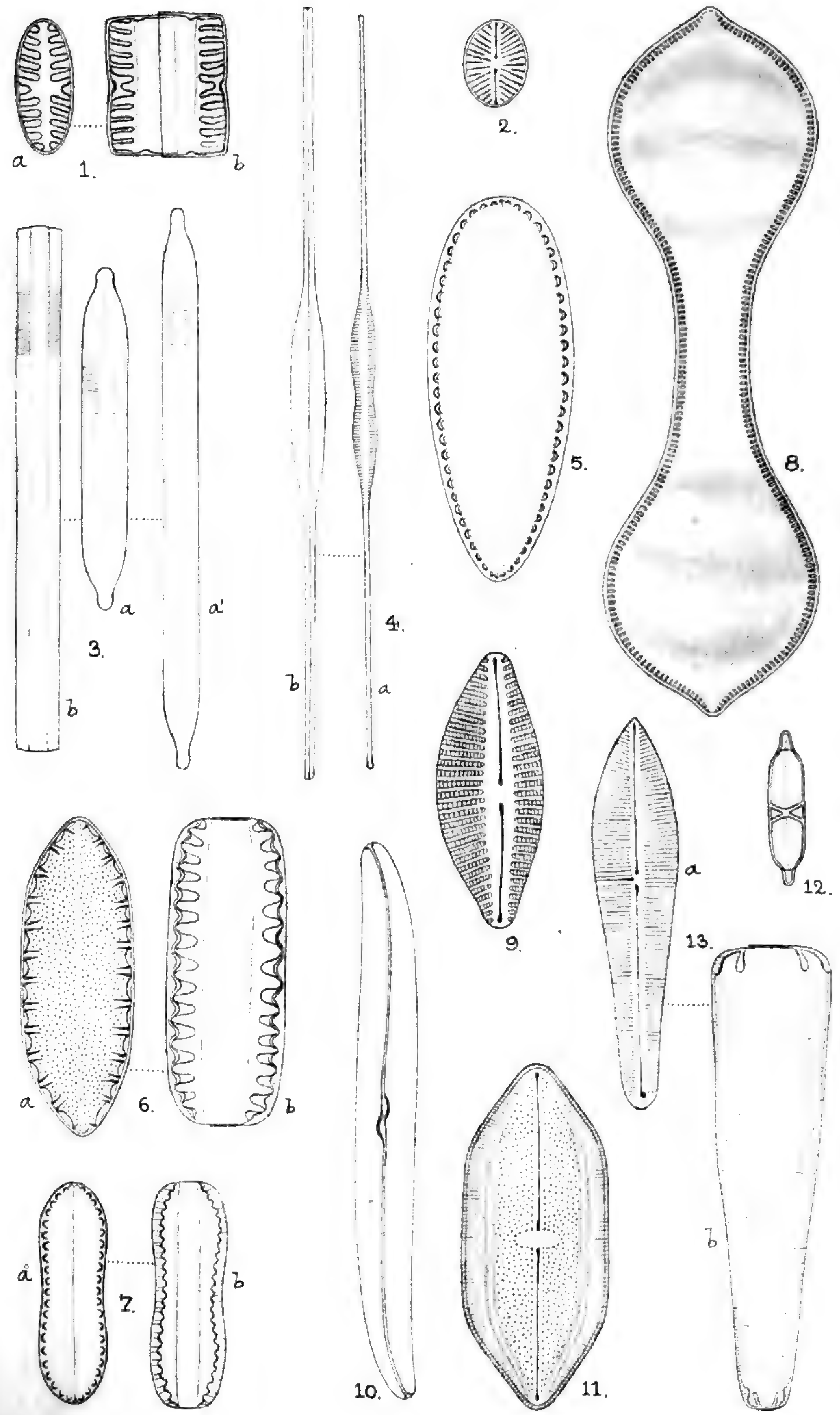

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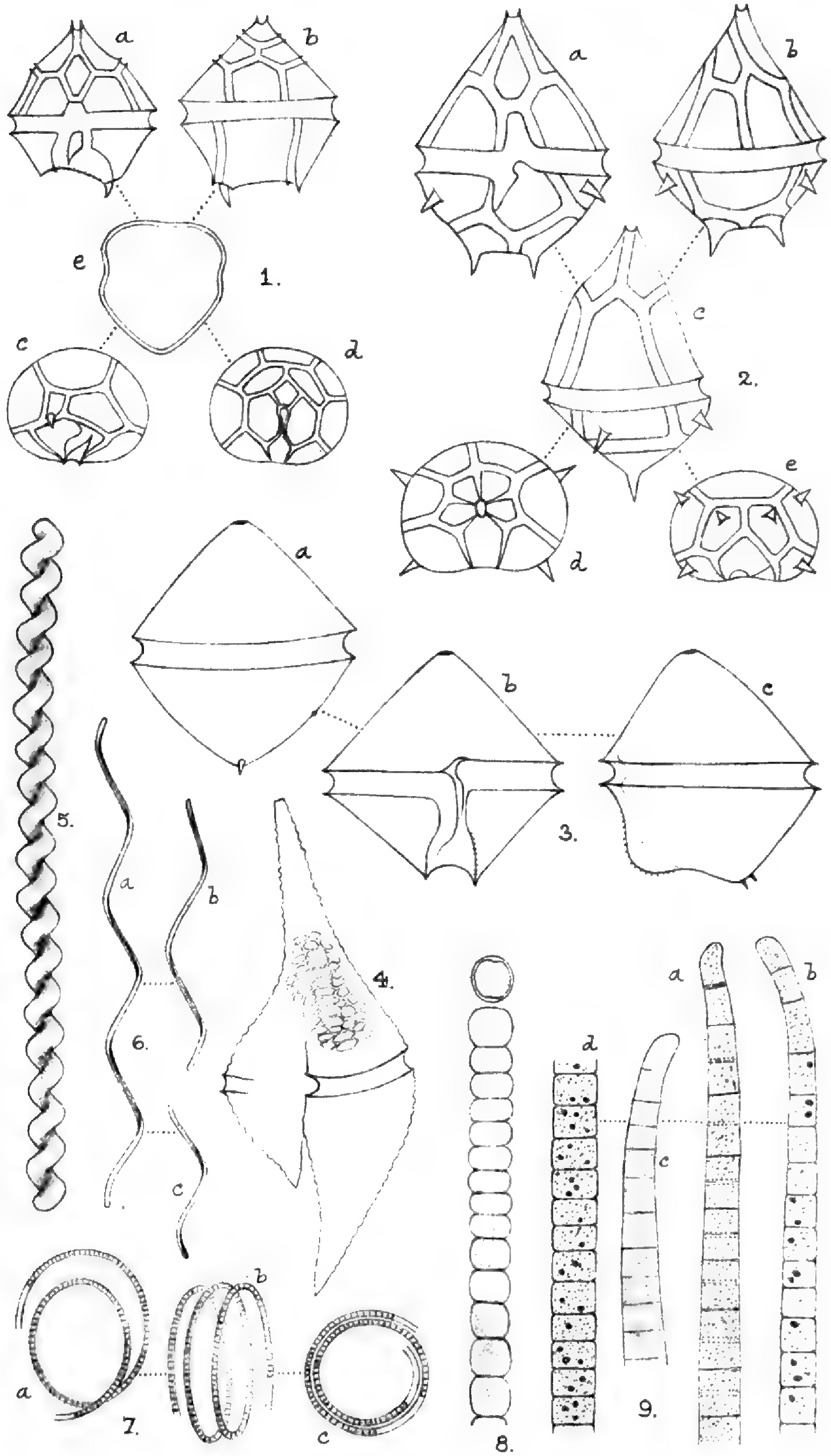

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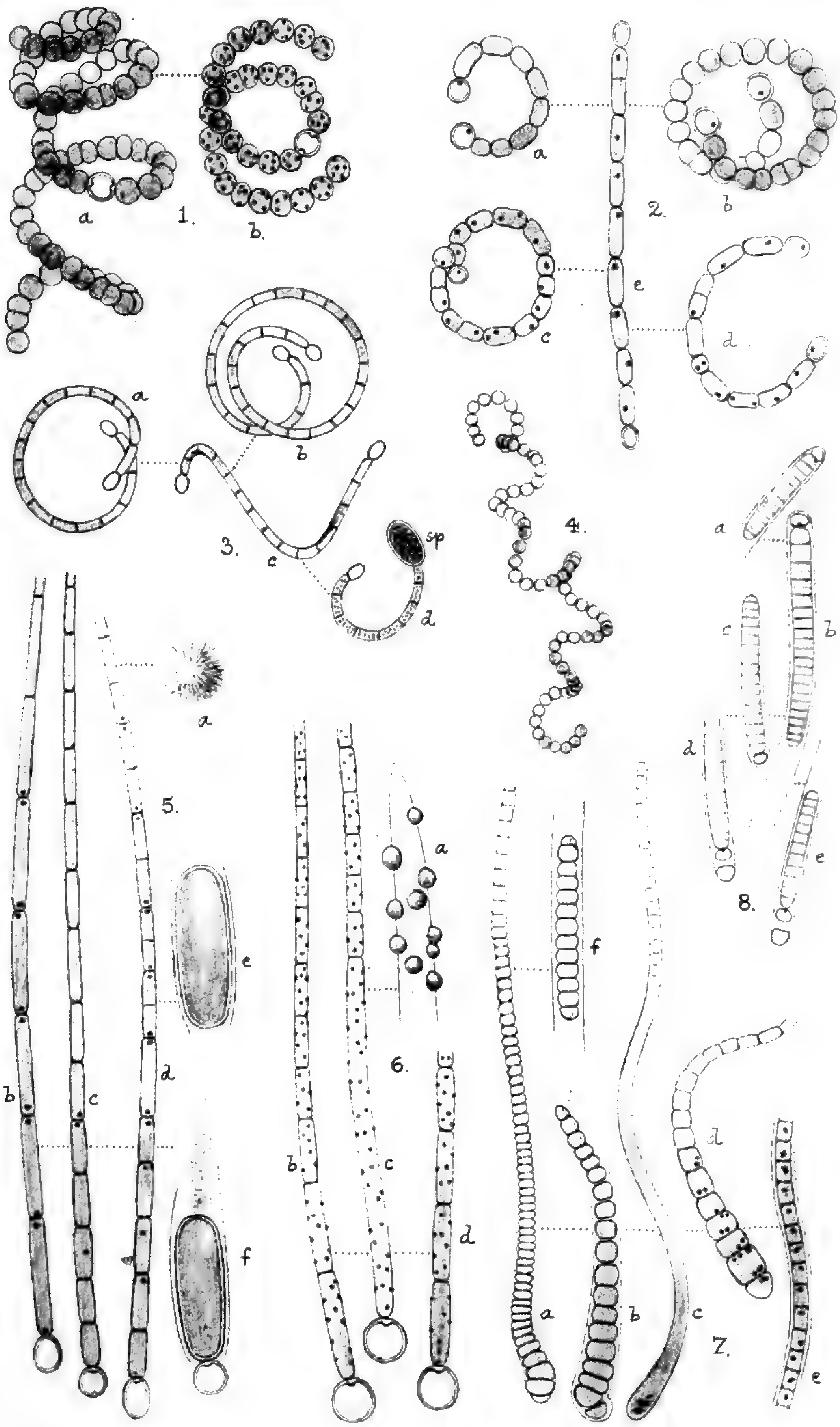

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AFRICAN ALGAE.

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BOTANY

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THE JOURNAL

OF

THE LINNEAN SOCIETY.

VOL. XXXVIII. BOTANY. No. 265.

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On the Distribution of the Species of Conifers in the several Districts of China, and on the Occurrence of the same Species in neighbouring Countries.

By the late MAXWELL T. MASTERS, M.D., F.R.S., F.L.S., Corresponding Member of the Institute of France (Académie des Sciences).

[Read 20th June, 1907.]

THE recent researches of Mr. E. H. Wilson in Sze-Chuan have brought to light a remarkably large number of new Conifers, which have been described by myself in the 'Journal' of the Society * and elsewhere. To Dr. Henry we are also indebted for the discovery of new species in Central China and Yunnan. The discoveries of Delavay and Franchet had been previously noted by Franchet. This large accession of hitherto undiscovered species provides matter for the consideration of the botanical geographer, and it is with a view of facilitating his task that I now venture to lay before the Society some details relating to the distribution of the Coniferæ and Taxaceæ in the various provinces of China and in neighbouring countries. For reasons which will readily be understood, the figures given must be taken as only approximately correct, as they are likely to be more or less modified as errors are detected and our acquaintance with the details becomes widened. Some discrepancies between the figures and details here given and those published in former communications, especially in my paper on the Conifers of Japan †, are to be accounted for, not only by the increased number of species now known, but by the transfer of certain species from one genus to another ; but these discrepancies do not affect the general conclusions arrived at.

The total number of species now known from China, inclusive of Formosa, amounts to 87, distributed through 23 genera, as shown in Table I.

Speaking broadly, a marked difference may be noted in the Coniferous floras of Northern, Southern, Central, and Western China respectively. Thus in the north we have such Pines as *Pinus Bungeana*, as well as *Picea obovata*, *Abies firma*, *A. Veitchii*, and two or three species of Larch, all indicating an approximation to the Flora of Japan and even of Northern Asia.

The Southern species are of a tropical or subtropical category. Among them are species of *Podocarpus*, also *Pinus Massoniana*, which, though it occurs in other parts of China, is more particularly a characteristic of the South, and indicates an approach to the Flora of the Philippine Islands, although there are no species in common. In Central China the Coniferous elements are mixed, but, so far as at present known, *Pinus Henryi* and *P. scipioniformis*

* Journ. Linn. Soc., Bot. vol. xxxvii. (Nov. 1906), pp. 410 *et seq.*

† *Op. cit.* vol. xviii. (1881) p. 483.

TABLE I.—Showing the Distribution of the Genera of Conifers in China and Japan.

	China.		Japan.	
	Total.	Peculiar.	Total.	Peculiar.
Libocedrus	1	1		
Thuya	2	1	3	2
Cupressus (including *Chamæcyparis*)	3	1	2	2
Juniperus	7	..	5	1
Cryptomeria	1	..	1	
Taiwainia (Formosa)	1	1		
Glyptostrobus	1	1		
Cephalotaxus	6	1	3	
Taxus	1	..	3	1
Torreya	2	1	1	
Ginkgo	1	..	1	
Dacrydium	1	1		
Podocarpus	6	2	4	? 2
Cunninghamia	1	1		
Sciadopitys (Japan only)	..	..	1	1
Pinus	13	7	5	1
Picea	14	9	5	
Keteleeria	4	4		
Tsuga	? 5	2	2	1
Pseudotsuga	1	..	1	
Abies	7	4	6	3
Pseudolarix	1	1		
Larix	8	4	5	1
Totals	87	42	48	15

are peculiar to this region, as well as *Picea Neoveitchii*, *P. Wilsoni*, and *Abies Fargesii*.

In South-Western China we have an approximation to the tropical Floras of Burma and neighbouring countries, as is evidenced by the presence of some species of *Cephalotaxus*, *Podocarpus*, *Pinus yunnanensis*, *P. densata*, and *P. prominens*. A relationship to the Floras of the Eastern Himalayas, Sikkim, and Assam is shown in certain species found in the West of China near the Tibetan frontier, especially certain species of *Cephalotaxus*, such as *C. Oliveri*, *C. Mannii*, *Taxus baccata*, certain species of *Podocarpus*, *Pinus*, *Picea*, *Tsuga*, *Abies*, and *Larix*.

The numbers of species in Japan, as indicated in Table I., show, on the whole, that there is a considerably less degree of relationship (so far as Conifers are concerned) between the Floras of the two countries than might have been anticipated. Hayata, however, points out that the Floras of Japan and Formosa have a close relation, notwithstanding the proximity of Formosa

to the mainland of Southern China *. From the tables he gives it is apparent that Japan has 12 of the Formosan species of Conifers, or 70 per cent.; North China 7 = 41 per cent.; Central China 10 = 59 per cent.; India 1 = 6 per cent.

Japan and China have, says Hayata, a great number of Conifers in common with Formosa. But, so far as India is concerned, he finds only one species, *Juniperus sinensis*, common to the Floras of India, Japan, and Formosa. The same writer points out that North America has as many as 9 genera in common with Formosa, a fact which leads him to speculate on the possibility of a former land-connection between America and Formosa by way of the Aleutian and Kurile Islands, Japan, and the Loo-Choo Islands. Mr. Hayata shows that the Floras of Japan, Formosa, Central and North China are closely related to each other, forming one Chino-Japanese Flora, which he divides into two subdivisions or "florules," one including North China, Japan, and Formosa, the other including South and Central China.

With reference to the origin of Conifers still represented by living examples in the northern hemisphere, M. Flahault concludes from palæobotanical evidence that they originated in the circumpolar regions of the Palæarctic continent. Thus species of *Taxodium*, *Pinus*, and *Picea* have been found in Tertiary or Oligocene deposits in Grinnell-land, lat. 81° 46′ N.; whilst the Miocene of Greenland contains evidence of the presence of *Taxodium*, *Glyptostrobus*, *Sequoia*, *Cephalotaxus* or *Taxus*, *Cupressus* (§ *Chamæcyparis*), and *Pinus*. In the Miocene deposits of Spitzbergen, N. lat. 78°, the same genera with *Picea* and *Abies*, but excluding *Cephalotaxus* or *Taxus*, have been observed. Many of these genera have also been recognized in Siberia, Alaska, Sachalin, in polar Western America, and in Iceland. In Miocene times *Sequoia*, *Taxodium*, and *Glyptostrobus* existed in Western Europe. In Nebraska, U.S., at the same period *Abies*, *Picea*, and *Larix* were represented as they now are in Central Europe; whilst in more remote ages Araucarias were living in Oolitic times, *Cedrus* and *Abies* in infra-Cretaceous periods, and *Podocarpus* in Eocene times. These details are taken from Prof. Flahault's recent memoir on "Les progrès de la Géographie Botanique depuis 1884," in 'Progressus Rei Botanicæ' (1907), p. 291.

The annexed Table II. gives an enumeration of all the species of Conifers known to inhabit Chinese territory. Their distribution in the several districts of the Empire—North, North-West, Central, East, West, South-West, South, and in the island of Formosa—is shown, together with an indication of the occurrence of the same species in neighbouring districts of Japan, Loo Choo, Corea, Manchuria, Eastern Himalayas, Assam, North Burma, Mongolia, and Siberia. So far as Tibet is concerned, the information at our disposal is at present too scanty to allow of definite statements. Wilson's researches on the

* Hayata, "On the Distribution of the Formosan Conifers," Botanical Magazine, Tōkyō, vol. xix. 1904, p. 43.

East Tibetan border are included in the columns relating to Western and South-Western China. Other indications point to an affinity between the species of Northern Tibet and Northern China.

The following remarks have reference to individual genera and species.

The LIBOCEDRUS was at first thought to be confined to Formosa, but it has since been found in Yunnan. Other species occur in New Zealand, the Chilian Andes, and N.W. America, but none has, so far, been detected in Japan. The genus is known to occur in the Cretaceous beds and in the Tertiary strata (Zeiller).

THUYA is represented by the widely-spread *T. orientalis* and by a species, *T. sutchuenensis*, found on the mountains of Sze-Chuan, and closely allied to the N.W. American *T. plicata*, Donn, and to the Japanese *T. japonica*. Three species are named as occurring in Japan, of which two are peculiar to that country.

CUPRESSUS has one species peculiar to Formosa, whilst the elegant *C. funebris* is found also in Sikkim, but perhaps only in a cultivated state. *C. sempervirens* has been probably introduced. It is noteworthy that up to the present time no species of the section *Chamæcyparis* has been met with in China, nor any *Retinospora* (so called) such as are so common in Japan.

There are seven species of JUNIPERUS indicated, but none peculiar to China unless as a varietal form. The species occur in the Temperate Himalaya, Japan, Siberia, and even Europe. *J. sinensis* is remarkable for the frequency with which it retains in adult life the juvenile or *Retinospora* stage of foliage, even on the same branch with the adult leaves. Five species of *Juniperus* are known from Japan, of which *J. nipponica* is peculiar to that country.

CRYPTOMERIA is probably only cultivated in China, but native to Japan.

TAIWAINIA is a newly described genus from Formosa (see Hayata, in Journ. Linn. Soc., Bot. vol. xxxvii. (1906) p. 330, pl. 16).

GLYPTOSTROBUS HETEROPHYLLUS is peculiar to Southern China. It is allied to but distinct from the *Taxodium* of Florida, of California, and of Mexico *.

Of CEPHALOTAXUS there are six species, of which only one, *C. Fortunei*, is peculiar to China. Three species are found in Japan, of which one is peculiar to that country. *C. Mannii* has been discovered in the Eastern Himalayas as well as in Western China.

TAXUS is represented by *T. baccata*, which is well-nigh ubiquitous in the northern hemisphere. Whether there is one variable species or several specifically distinct is a question upon which botanists are not agreed †.

* Masters on *Taxodium* and *Glyptostrobus*, in 'Journal of Botany,' xxxviii. (1900) pp. 37–40.

† See Pilger, in 'Pflanzenreich,' Taxaceæ (1903), p. 110.

Table II.—Containing a list of all the species of Conifers known to be natives of China and showing their distribution in the various districts of the Empire as well as in neighbouring countries.

	CHINA.															
	North.	North-West.	Central.	East.	West.	South-West.	South.	Formosa.	Japan & Loo Choo.	Corea.	Manchuria.	E. Himalayas.	Assam & N. Burma.	Mongolia.	Siberia.	
Libocedrus																
macrolepis	...	...	...	...	...	×	...	×								
Thuya																
orientalis.........	×	×	×	...	×	..	×	×	×	...	...	×	...	...	×	W. Himalaya. Turkestan.
sutchuenensis ...	...	...	...	..	×	× ?										
Cupressus																
formosensis ...	...	...	...	...	...	...	...	×								
funebris	×	×	×	×	×	...	×	...	...	...	...	×				
sempervirens ...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	Cult ?
Juniperus																
chinensis	×	...	×	×	...	...	×	...	×	×						
communis	×	...	×	×	×	...	×	...	×	×						
nipponica	...	...	...	...	...	...	...	..	×							
litoralis	...	...	...	...	...	×	...	...	×							
recurva	×	...	×	...	×	×	×	...	...	...	...	×				
rigida	×	...	...	...	...	×	...	...	×	×	...	...	...	×		
sphærica	×															
taxifolia	...	...	×	×	×	...	×	...	×							
Cryptomeria																
japonica	...	...	×	×	×	×	×	...	×							
Taiwainia																
cryptomerioides.	...	...	...	...	...	...	...	×								
Glyptostrobus																
heterophyllus ...	...	...	...	...	...	...	×									
Cephalotaxus																
drupacea	...	...	×	...	...	...	...	×	×							
Fortunei	...	...	×	×	×	×										
Griffithii	...	...	×	...	...	...	...	...	...	...	...	...	×			
Mannii	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	Khasia.
Oliveri	...	...	×	...	×	×										
pedunculata ...	×	...	...	...	...	...	...	×	...	×						
Taxus																
baccata............	×	...	×	...	×	...	...	...	...	...	...	×				
Torreya																
grandis	...	...	...	×												
nucifera	...	...	×	...	×	...	...	...	×							
Fargesii	...	...	×	...	×											
Ginkgo																
biloba	×	...	...	×	×	×	...	...	×	...	...	...	...	...	...	Doubtful; cult.
Dacrydium																
Beccarii	...	...	...	...	...	...	×									
Podocarpus																
argotænia	...	...	...	...	...	...	×	×								
chinensis.........	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Cult.
latifolia	...	...	...	...	...	...	×	×	×	...	...	...	...	...	...	Malaya.
macrophylla ...	...	...	×	×	×	×	...	×	×							
neriifolia	...	...	...	...	×	...	...	...	×	...	...	...	...	...	...	Malaya.
sutchuenensis ...	...	...	...	...	×											
Cunninghamia																
sinensis	×	...	×	×	×	×	×	×								
Sciadopitys																
(Japan only) ...	...	...	...	...	...	...	...	...	×							
Pinus																
Armandi	×	×	...	...	×	×										
Bungeana	×	×	×													

	CHINA.														
	North.	North-West.	Central.	East.	West.	South-West.	South.	Formosa.	Japan & Loo Choo.	Corea.	Manchuria.	E. Himalayas.	Assam & N. Burma.	Mongolia.	Siberia.
Pinus (*cont.*).															
densata	...	...	...	...	×										
densiflora	×	...	...	×	...	×	...	...	×	×					
Henryi	...	...	×												
koraiensis	×	...	×	...	×	...	...	×	×	×	×				
luchuensis	...	...	...	...	...	...	...	...	×						
mandshurica	...	...	...	...	×	×									
Massoniana	×	...	×	×	...	×	×	×	×						
prominens	...	...	...	...	×										
scipioniformis	...	...	×												
Thunbergii	×	...	...	..	×	×	...	...	×	×					
yunnanensis	...	...	...	...	×	×									
Picea															
ajanensis	...	...	×	...	×	...	...	...	×	...	...	...	...	×	
Alcockiana	..	..	...	...	×	...	...	...	×	...	...	...	...	×	
asperata	...	...	...	...	×										
aurantiaca	...	...	...	...	×										
brachytila	...	...	...	...	×	×	×								
Glehni	...	...	...	...	...	...	...	×	×	...	×				
likiangensis	...	...	...	...	...	×									
Mastersii	×														
Maximowiczii	...	...	?	...	...	...	...	...	×						
Neoveitchii	...	...	×												
obovata	×	...	...	...	...	?									
retroflexa	...	...	...	...	×										
Watsoniana	...	...	...	...	×										
Wilsoni	...	...	×												
Keteleeria															
Davidiana	...	...	×	...	×	×									
Evelyniana	...	...	...	...	...	×									
Fabri	...	...	...	×											
Fortunei	...	...	...	×	...	×									
Tsuga															
Brunoniana	...	...	...	...	×	×	...	...	...	...	...	×			
chinensis	...	...	...	...	...	×									
diversifolia	...	...	...	...	...	...	×	×							
Sieboldi	×	...	×	...	×	...	...	...	×						
yunnanensis	...	...	×	...	...	×									
Pseudotsuga															
japonica	...	..	...	...	...	...	...	×	×						
Abies															
Delavayi	...	...	...	...	×	×									
Fargesii	..	...	×	...	×										
firma	×	...	...	...	×	...	×?	...	×	×	×				
recurvata	...	...	...	...	×		...								
sachalinensis	...	...	...	...	...	...		×	×						
squamata	...	...	...	...	×										
Veitchii	×	...	...	..	...	...	...	...	×	...	×				
Pseudolarix															
Fortunei	...	...	...	×											
Larix															
chinensis	×														
davurica	×	...	..	...	...		...	...	...	...	×				
Griffithii	...	...	...	...	...	×	...	...	...	...	..	×			
leptolepis	...	...	...	...	...	...	...	...	×						
Potanini	...	...	...	...	...	×									
Rupprechti	×														
sibirica	×	...	...	...	..	...	...	..	...	...	...	×	...	×	
tibetica?	...	...	...	×											

TORREYA GRANDIS and *T. Fargesii* are exclusively Chinese, whilst *T. nucifera* occurs also in Japan.

GINKGO BILOBA, an interesting survival of over sixty species known in a fossil state, is found both in China and in Japan generally in a cultivated condition in the vicinity of the temples, but Mrs. Bishop records it as native both in Western China and in Northern Japan.

DACRYDIUM BECCARII of Parlatore is reported from Hainan, but I have no information concerning it. Pilger, in the 'Pflanzenreich,' Taxaceæ (1903) p. 52, does not mention it as native to China.

Six species of PODOCARPUS are enumerated, but their identification is by no means certain. Two species are probably exclusively Chinese, viz., *P. argotænia*, Hance, and *P. sutchuenensis*, Franchet. The others are found also in Japan (three species), the Malay Peninsula, &c. Pilger mentions *P. chinensis*, of Blume, at p. 93, but gives no locality. The same author refers *P. argotænia* to a separate genus.

CUNNINGHAMIA SINENSIS is exclusively Chinese and Formosan.

SCIADOPITYS is exclusively Japanese.

Of PINUS no fewer than thirteen species are recorded from China. Of these at least seven, so far as at present known, are peculiar to that country. They are *P. scipioniformis*, Mast., *P. yunnanensis*, Franchet, *P. Armandi*, Franchet, *P. Bungeana*, Zuccarini, *P. Henryi*, Mast., *P. densata*, Mast., *P. prominens*, Mast. The remaining Chinese species are natives also of Japan, Korea, and Manchuria. *P. yunnanensis* is allied to *P. khasya*, from the Himalaya, to a species collected in Manipur by Sir George Watt, as well as to *P. insularis* from the Philippines *. Five species in all are recorded from Japan and Loo Choo (not including varieties).

PICEA, Link, is exceptionally well represented in China, there being no fewer than fourteen species recorded, of which nine are endemic. One species belongs to the flat-leaved section, of which the Japanese *P. ajanensis* forms one member, *P. sitchensis*, from N.W. America, another, whilst S.E. Europe has its representative in *P. Omorica*. Other Chinese Spruces with four-sided leaves occur on the mountains of Western China, Sze-Chuan, Yunnan, and especially on the mountains by the Tibet border; such are *P. Watsoniana*, in addition to *P. purpurea* and *asperata*. From Japan only five species have been recorded, *P. polita* being the only peculiar species.

It would thus seem that Western China was an important centre of distribution for species of *Pinus* and *Picea*, and to a less extent for species of *Abies*.

* See Brandis, 'Indian Trees' (1906), p. 690.

Keteleeria is represented by four species, all endemic and occurring in Central, Western, and Southern China, including one remarkable species, *K. Evelyniana*, discovered by Dr. Henry in Yunnan.

Tsuga has from three to five species enumerated, of which *T. chinensis* and *T. yunnanensis* are confined to China, the other species being found also in Japan, and one, *T. Brunoniana*, in the Eastern Himalayas. There are two American species, one on the Atlantic, the other on the Pacific side of the Northern United States. It seems probable that some of the reputed Chinese species will hereafter not be considered distinct, but as varieties of *T. Sieboldi.*

Pseudotsuga japonica, the analogue of the Douglas Fir of N.W. America, occurs in Japan and also in Formosa.

Abies, including the Silver Firs, is credited with seven species, of which some are common to Japan and four are peculiar to China. Of these four, two are remarkable species discovered by Wilson in the Min Valley and near Tatien-lu. Six species inhabit Japan, three exclusively. Some of the West Chinese species indicate an affinity with *A. Webbiana* and other East Himalayan species.

Pseudolarix Fortunei, Mayr, is the only representative of the genus, and occurs in Chekiang and Kiukiang.

Of the true Larches, Larix, eight species are enumerated, but they are not well defined, and it is probable that with increased knowledge some may be reduced. Four are recorded from China only, and one, *L. Griffithii*, which occurs in West Sze-Chuan, is found also in the Eastern Himalaya. A single species is peculiar to Japan.

On the Pre-Glacial Flora of Britain.

By Clement Reid, F.R.S., F.L.S., and Eleanor M. Reid, B.Sc.

(Plates 11–15.)

[Read 20th June, 1907.]

The plants living in Britain immediately before the cold of the Glacial Epoch have attracted attention for many years. A certain number of species were collected as far back as 1861 by the Rev. S. W. King. These were determined by Heer, and Lyell published his list, amounting to twelve species *. A few more were added later on; but in 1877, when the Geological Survey commenced the examination of the Norfolk and Suffolk coast, the list was still under twenty species.

In the course of this survey a number of seeds and leaves were collected (by C. R.), and this collection, which was mainly determined by Mr. Carruthers, amounted to nearly thirty species †. It is now in the Museum of Practical Geology, as is the King collection. This small list was of so much interest that after the survey was finished the work was continued during holiday visits. A collection of ripe seeds of British plants (so poorly represented in recent herbaria) was slowly formed, and the fossil flora gradually crept up to fifty-six species in 1890 ‡, and to seventy-eight in 1899 §.

The work of the last few years has led to the discovery of so many additions to this meagre list, that the time has now arrived for a revision of our pre-Glacial flora. This is the more necessary, as on the character of this flora depends the geologist's view of the climatic conditions which then prevailed. We want also to take a census of the plants, in order to understand what amount of change and extermination took place during the forced migrations consequent on the cold period which supervened. And, thirdly, we should like to know what variation the species have undergone during a period of many thousand years.

As regards the certainty of the determinations, it may be as well to say at once that in the case of seeds and fruits—and it is on these that we mainly rely—there is seldom any doubt in either recent or well-preserved fossil specimens. Almost every species that can be distinguished by other characters can be distinguished also by the seed alone; and often the seed or fruit, though apparently undescribed, gives better specific characters than the whole of the rest of the plant. The cases where there is doubt are usually seeds of plants belonging to closely allied species, which give almost as much difficulty when we compare the whole plant. Thus we do not

* 'Antiquity of Man,' 4th ed. 1873, p. 256.

† C. Reid, "Geology of the Country around Cromer," Mem. Geol. Survey, 1882, pp. 62–64.

‡ C. Reid, "Pliocene Deposits of Britain," Mem. Geol. Survey, 1890.

§ C. Reid, 'The Origin of the British Flora,' 8vo, 1899.

pretend to be able to distinguish the different fruticose *Rubi* by their stones, nor can we find satisfactory specific characters in the carpels of *Rosa*, or of the Batrachian *Ranunculi*. The closely allied *Stellaria media*, *S. Boraeana*, and *S. neglecta*, however, have seeds noticeably different ; *Arum maculatum* and *A. italicum* have seeds remarkably distinct.

Seeds (or the hard parts of fruits) being thus critically distinguishable, it seems advisable to place on record the evidence by which we have been guided in determining the fossil plants. This is the more necessary as many of the seeds are impregnated with pyrites, which tends to decompose and to destroy the specimen. For this reason it is important to preserve exact photographic representations, so that if the fossil itself disappears there may still be a satisfactory record of its discovery *.

Fruits and seeds of our recent plants are seldom figured and described in such a way as to enable the botanist to recognise them specifically, especially if detached from the plant. Seeds are constantly described as smooth or shining, when in reality they have a highly characteristic sculpture, only masked by a coat of varnish. Our fossil fruits and seeds also are preserved in an altered state, the alteration in some cases being so great that their identity with the living plants is not suspected until recent seeds have been reduced by maceration or carbonising to a similar condition. It is not that the fossils are less determinable than the recent, often the intricate patterns on the outside are far clearer. But any botanist finding, for instance, fossil fruits of *Conium* in the state of preservation shown on Pl. **12**. fig. 60 would not recognise them, unless he had treated the recent fruits in such a way as to remove their ridges. In this case slow carbonising shows the identity of the recent with the fossil fruit, and this carbonising also causes the recent fruit to shrink till it is as small as the fossil specimens. This difficulty of comparison has given much trouble, and in many cases we have had the fossil for years before we recognised it as being the seed or fruit of a common British plant.

It would need a large number of magnified photographs to illustrate all the details of cell-structure, etc., on which our determinations have been based ; but the figures and descriptions now given should be sufficient at any rate to help the botanist, and to prevent the geologist and archæologist from throwing away what looks like most unpromising material for the study of an ancient flora.

The mode of collecting and washing the material need not again be described ; but a few words are required as to the best methods of preserving the seeds in such a state as to be fit for study. One remark, however, must be made as to the preliminary work. Fossil seeds if possible should not be allowed to dry, at any rate not after they have been taken out of the

* We have not thought it necessary to reproduce our photographs of the leaves, as the forms and venation of leaves are well known, and the specimens themselves are generally preserved in slabs of ironstone.

clay in which they are found. In drying they shrink, become distorted, or often crack and fall to pieces. It is generally necessary, however, to dry the lumps of clay in which the seeds are contained, or they will not fall to pieces when placed in water; but this drying when tightly packed in a rigid matrix does comparatively little harm. After the clay has fallen to pieces in water the seeds should be collected while still wet and transferred from dish to dish of clean water, till they are in a fit state for the next process.

Pyritised fossils can be preserved fairly well under water; but in this wet state they can neither be studied conveniently nor photographed. If absolute alcohol is used for drying, the seed shrinks and is injured. We wish to preserve them in such a way that they can be safely handled, turned over, compared side by side with recent seeds, and, if necessary, dissected. They must therefore be impregnated with some medium that will protect the pyrite granules from the air, that will prevent the seed from becoming distorted or falling to pieces, and that will leave the surface sculpture intact and in a state fit for photographing. The process must not be too elaborate, as we have to deal with thousands of seeds in a short time.

The method we now employ is as follows:—The specimens are removed a few at a time from the store-bottles in which they have accumulated, and are washed in clean water to remove the weak formalin or salicylic acid used for their temporary preservation. A thin film of wax (we have used "paraffin filtr. 45° Grübler & Co.") is melted on a glass plate or slide and allowed to harden. The seeds or leaves are removed from the water and are placed, still wet, on the prepared film; the plate is then *immediately* warmed from below to a temperature just sufficient to melt the wax. As the moisture evaporates from the upper surface of the specimen the wax is absorbed from the lower, and in a few minutes, unless the seed is very large, the process is complete, the whole seed is impregnated with wax, and it is rendered so tough that it can easily be handled.

When the seeds have absorbed as much wax as they can, they are transferred to a clean part of the plate and the superfluous wax is removed with warm filter-paper; or they can be allowed to cool thoroughly and then have their surfaces brushed with benzine. If one surface of the seed is better preserved than another, that surface should be placed in contact with the wax, for the lower surface remains uninjured and flat even if the upper surface suffers slightly.

In the determination of the species now to be recorded, we have received invaluable assistance from the British Museum and Kew collections, and from recent seeds supplied to us by Mr. James Groves. Dr. Rendle also has kindly examined our specimens belonging to the genera *Najas* and *Zannichellia*, the discoveries in the former genus being recorded in his monograph *. Our

* Trans. Linn. Soc. ser. 2, Bot. vol. v. (1899) p. 436.

collection of recent seeds is steadily growing, but there are still too many species of which we have been unable to obtain ripe fruits ourselves, or to find perfectly ripe fruits in the herbaria. Until, also, we can obtain a more complete series of Palæarctic plants, it will be impossible to say whether some of the various undetermined seeds belong to living or to extinct species; we have decided therefore not at present to describe any species as new, though in all probability two or three are no longer living.

The plant-remains from the pre-Glacial deposits of the Norfolk and Suffolk coasts belong to the following species:—

RANUNCULACEÆ.

Thalictrum flavum, *Linn.*
Ranunculus aquatilis, *Linn.*
R. sceleratus, *Linn.*
R. Flammula, *Linn.*
R. Lingua, *Linn.*
R. repens, *Linn.*
R. nemorosus, *DC.*
R. sp. 7.
R. sp. 8.
Caltha palustris, *Linn*

NYMPHÆACEÆ.

Nymphæa lutea, *Linn.* (Nuphar luteum, *Sibth. & Sm.*).
Castalia alba, *Woods* (Nymphæa alba, *Linn.*).
Two undetermined species.

PAPAVERACEÆ.

Hypecoum procumbens, *Linn.*

VIOLACEÆ.

Viola palustris, *Linn.*
V. cf. hirta, *Linn.*
V. cf. Riviniana, *Reichb.*

CARYOPHYLLEÆ.

Stellaria aquatica, *Moench.*
S. media, *Villars.*
S. Holostea, *Linn.*
Arenaria serpyllifolia, *Linn.*

ELATINEÆ.

Elatine Hydropiper, *Linn.*

HYPERICINEÆ.

Hypericum quadrangulum, *Linn.*
H. hirsutum, *Linn.*

RHAMNEÆ.

Rhamnus Frangula, *Linn.*

SAPINDACEÆ.

Acer campestre, *Linn.*

ROSACEÆ.

Prunus spinosa, *Linn.*
Spiræa Ulmaria, *Linn.*
Rubus Idæus, *Linn.*
R. fruticosus, *Linn.*
Potentilla silvestris, *Neck.*
Alchemilla arvensis, *Scop.*
Pyrus Aria, *Ehrh.*
P. Malus, *Linn.*
Cratægus Oxyacantha, *Linn.*
C. sp. ?

HALORAGEÆ.

Hippuris vulgaris, *Linn.*
Myriophyllum spicatum, *Linn.*

ONAGRARIEÆ.

Trapa natans, *Linn.*
Circæa lutetiana, *Linn.*

UMBELLIFERÆ.

Conium maculatum, *Linn.*
Apium sp.
Cicuta virosa, *Linn.*
Chærophyllum sylvestre, *Linn.*
Œnanthe Lachenalii, *C. C. Gmel.*
Œ. Phellandrium, *Lam.*
Æthusa Cynapium, *Linn.*
Pastinaca sativa, *Linn.*
Heracleum Sphondylium, *Linn.*
Torilis Anthriscus, *Bernh.*

Cornaceæ.
Cornus sanguinea, *Linn.*

Caprifoliaceæ.
Viburnum Opulus, *Linn.*
V. sp. 2.
V. sp. 3?

Rubiaceæ.
Galium Aparine, *Linn.*

Valerianeæ.
Valeriana sambucifolia, *Willd.*
Valerianella olitoria, *Poll.*

Compositæ.
Eupatorium sp.?
Bidens tripartita, *Linn.*
Tussilago Farfara, *Linn.*
Arctium sp.
Carduus nutans, *Linn.*
C. cf. nutans.
C. palustris, *Linn.*
C. heterophyllus, *Linn.*
Centaurea sp.
Picris hieracioides, *Linn.*
Crepis succisæfolia, *Tausch.*
Leontodon autumnalis, *Linn.*

Gentianeæ.
Menyanthes trifoliata, *Linn.*

Solanaceæ.
Solanum Dulcamara, *Linn.*

Scrophularineæ.
Verbascum Thapsus, *Linn.*
Limosella aquatica, *Linn.*
Veronica Chamædrys, *Linn.*

Labiatæ.
Mentha aquatica, *Linn.*
Lycopus europæus, *Linn.*
Calamintha arvensis, *Lam.*
Prunella vulgaris, *Linn.*
Stachys sylvatica, *Linn.*
S. arvensis, *Linn.*
Ballota nigra, *Linn.*
Ajuga reptans, *Linn.*
Two undetermined genera.

Plantagineæ.
Littorella juncea, *Berg.*

Chenopodiaceæ.
Chenopodium album, *Linn.*
C. rubrum, *Linn.*
Atriplex hastata, *Linn.*?

Polygonaceæ.
Polygonum Convolvulus, *Linn.*
P. aviculare, *Linn.*
P. Persicaria, *Linn.*
P. amphibium, *Linn.*
Rumex maritimus, *Linn.*
R. obtusifolius, *Linn.*
R. Hydrolapathum, *Huds.*
R. acutus, *Linn.*?
R. Acetosella, *Linn.*

Euphorbiaceæ.
Euphorbia amygdaloides, *Linn.*

Urticaceæ.
Ulmus montana, *Stokes*?
Urtica dioica, *Linn.*
U. urens, *Linn.*?

Cupuliferæ.
Betula alba, *Linn.*
Alnus glutinosa, *Gaertn.*
A. sp.
Carpinus Betulus, *Linn.*
Corylus Avellana, *Linn.*
Quercus Robur, *Linn.*
Fagus sylvatica, *Linn.*
Salix cinerea, *Linn.*
S. sp. 2.
S. sp. 3.

Ceratophylleæ.
Ceratophyllum demersum, *Linn.*

Coniferæ.
Taxus baccata, *Linn.*
Pinus sylvestris, *Linn.*
Picea excelsa, *Link.*

Hydrocharideæ.
Stratiotes Aloides, *Linn.*

Typhaceæ.

Sparganium erectum, *Linn.* ?

Alismaceæ.

Alisma Plantago, *Linn.*
Sagittaria sagittifolia, *Linn.*

Naiadaceæ.

Potamogeton natans, *Linn.*
P. heterophyllus, *Schreb.*
P. prælongus, *Wulf.*
P. perfoliatus, *Linn.*
P. crispus, *Linn.*
P. obtusifolius, *Mert. & Koch.*
P. pusillus, *Linn.*
P. trichoides, *Cham.*
P. pectinatus, *Linn.*
Zannichellia palustris, *Linn.*
Z. pedunculata, *Reichb.*
Najas marina, *Linn.*
N. minor, *Allioni.*

Cyperaceæ.

Eleocharis sp.
Scirpus fluitans, *Linn.*
S. lacustris, *Linn.*
S. Tabernæmontani, *C. C. Gmel.*
Eriophorum vaginatum, *Linn.*
Carex dioica, *Linn.*
C. muricata, *Linn.*
C. cf. helodes, *Link.*
C. hirta, *Linn.*
C. acutiformis, *Ehrh.*
C. riparia, *Curtis.*
C. rostrata, *Stokes.*
C. sp. 9.
C. sp. 10.
C. vesicaria, *Linn.*

Gramineæ.

Phragmites communis, *Trin.*

Filices.

Osmunda regalis, *Linn.*

NOTES ON THE PLANTS.

Thalictrum flavum, *Linn.* (Plate **11.** fig. 1.)

Achenes are not uncommon at several localities. They agree exactly with recent specimens.

Ranunculus aquatilis, *Linn.* (Pl. **11.** figs. 2, 3.)

Achenes are abundant and variable ; but we are unable to separate the different species of Batrachian *Ranunculi* from fruits alone. We must therefore leave them under the Linnean aggregate *Ranunculus aquatilis.*

Ranunculus sceleratus, *Linn.* (Pl. **11.** fig. 4.)

Indistinguishable from recent achenes. Found rarely at Beeston, Cromer, and Pakefield.

Ranunculus Flammula, *Linn.* (Pl. **11.** fig. 5.)

As yet only found at Pakefield.

Ranunculus Lingua, *Linn.* (Pl. **11.** fig. 6.)

Calls for no remark. Achenes have been found at Beeston and Pakefield.

RANUNCULUS REPENS, *Linn.* (Pl. **11.** fig. 7.)

Achenes are common at several localities and are usually well-preserved. They are clearly distinguishable both by their shape and the character of their punctation from *R. acris* and *R. bulbosus,* neither of which has yet been discovered.

RANUNCULUS NEMOROSUS, *DC.* (Pl. **11.** fig. 8.)

An achene resembling *R. repens*, but larger, with wider, more bevelled margin, sides more coarsely pitted, and ridges between the pits rounded instead of sharp. This agrees with *R. nemorosus* and does not correspond with any other European form. The species belongs to woods and shady piaces in Central and Southern Europe. The fossil was found at Pakefield.

RANUNCULUS sp. 7. (Pl. **11.** fig. 9.)

A single achene of *Ranunculus* found at Beeston is very large, elongate oval, with terminal style, and no margin, the sides are rounded but pinched in. We can find no *Ranunculus* with achenes resembling this; it must wait for more specimens.

RANUNCULUS sp. 8. (Pl. **11.** fig. 10.)

An achene from Pakefield, in shape much like *R. Lingua*, but the surface-pits are not elongated, We cannot match this ; but require more specimens for thorough examination.

CALTHA PALUSTRIS, *Linn.* (Pl. **11.** figs. 11, 12.)

Several seeds have been found at Mundesley and Pakefield; but the testa is so fragile that they are difficult to preserve.

NYMPHÆA LUTEA, *Linn.* (NUPHAR LUTEUM, *Sibth. & Sm.*). (Pl. **11.** fig. 13.)

Abundant at various localities.

CASTALIA ALBA, *Woods* (NYMPHÆA ALBA, *Linn.*). (Pl. **11.** fig. 14.)

This species was recorded in 1861 by the Rev. S. W. King, but till lately we could obtain no corroborative evidence, and some of Mr. King's specimens were certainly derived from a more modern deposit than the Cromer Forest-bed. We have now found two seeds at Pakefield. They are much crushed and damaged; but still show the very characteristic surface-sculpture, of which, however, we have not obtained a satisfactory photograph.

NYMPHÆACEÆ sp. 3. (Pl. **11.** fig. 15.)

Seed smaller than *N. lutea* and differing in shape and surface-pittings. It shows the characteristic funnel-shaped infolding of the testa, into which the embryotega fits, and the surface-sculpture also suggests Nymphæaceæ.

We require more material for the determination of this interesting seed, which belongs to no living water-lily of which we have yet been able to examine seeds.

NYMPHÆACEÆ sp. 4. (Pl. **11.** fig. 16.)

Two or three much damaged seeds that appear to belong to a fourth species of water-lily have been found at Pakefield. Length 4·3 mm.; testa with conspicuous rectangular pits arranged in lines. These also must wait for further material.

HYPECOUM PROCUMBENS, *Linn.* (Pl. **11.** fig. 17.)

Seeds of this plant are common at Corton and correspond exactly with those of the recent plant, which belongs to the Mediterranean region and Southern France.

All the species of this genus have the seed protected by a close mosaic of cubic crystals of oxalate of lime. These impress the testa with quadrangular pits; and traces of these thin-walled quadrangular pits are to be found on several of our specimens.

VIOLA PALUSTRIS, *Linn.* (Pl. **11.** fig. 18.)

Damaged seeds of *Viola* are common at various localities, but are seldom sufficiently well preserved for determination. Fig. 18 corresponds with *Viola palustris*.

VIOLA, cf. HIRTA, *Linn.* (Pl. **11.** figs. 19, 20.)

Many of the seeds of *Viola* belong to a larger form, closely resembling *V. hirta*, but slightly more slender than our recent seeds of that species.

VIOLA, cf. RIVINIANA, *Reichb.* (Pl. **11.** fig. 21.)

The majority of the seeds of *Viola* belong to a third species. They closely resemble *V. Riviniana*, but are larger than our recent seeds.

STELLARIA AQUATICA, *Moench.* (Pl. **11.** fig. 22.)
S. MEDIA, *Villars.* (Pl. **11.** fig. 23.)
S. HOLOSTEA, *Linn.* (Pl. **11.** fig. 24.)

These correspond so exactly with the recent seeds that no remark is needed. They were all found at Pakefield.

ARENARIA SERPYLLIFOLIA, *Linn.* (Pl. **11.** fig. 25.)

One perfect seed and one fragment are all that we have found of this species.

ELATINE HYDROPIPER, *Linn.* (Pl. **11.** fig. 26.)

Several seeds have been found at Pakefield.

HYPERICUM QUADRANGULUM, *Linn.* (Pl. **11.** fig. 27.)
H. HIRSUTUM, *Linn.* (Pl. **11.** fig. 28.)

The shape and sculpture of the testa in the different species of *Hypericum* are very characteristic, and the fossil seeds are well preserved. We have only as yet found these two species.

RHAMNUS FRANGULA, *Linn.* (Pl. **11.** fig. 29.)

Seeds are very scarce, and have only been found at Pakefield.

ACER CAMPESTRE, *Linn.* (Pl. **11.** figs. 30, 31.)

Trees of this maple must have overhung the small channel at Pakefield, for seeds, fragments of wings, and broken leaves are very plentiful.

RUBUS IDÆUS, *Linn.* (Pl. **12.** fig. 34.)

Two or three characteristic stones have now been found; it is much more scarce than *R. fruticosus.*

POTENTILLA SILVESTRIS, *Neck.* (Pl. **12.** figs. 36, 37.)

The carpels are very variable, but all seem referable to this species.

ALCHEMILLA ARVENSIS, *Scop.* (Pl. **12.** fig. 38.)

A few nuts of this plant have been found at Pakefield.

PYRUS ARIA, *Ehrh.*

We have only seen one damaged leaf of this tree. It is too black to photograph.

CRATÆGUS OXYACANTHA, *Linn.* (Pl. **12.** figs. 40–44.)

This species has only been found at Overstrand, where the fruits are very variable. Five have been figured, to show the range of variation.

CRATÆGUS sp.? (Pl. **12.** fig. 45.)

The fruit figured seems to belong to a second species of *Cratægus.* We have only one specimen, which was found at Pakefield.

TRAPA NATANS, *Linn.* (Pl. **12.** figs. 49–56.)

Several specimens are figured, to show the variability of these fruits.

CIRCÆA LUTETIANA, *Linn.* (Pl. **12.** fig. 59.)

Two fruits of this plant have been found at Pakefield. They are in a peculiar state of preservation, having lost their hooked hairs.

Conium maculatum, *Linn.* (Pl. **12.** fig. 60.)

These are well preserved, though the ridges have been lost. Even in Roman deposits, in which the fruits are very abundant, the ridges have disappeared.

Apium sp. (Pl. **12.** fig. 61.)

Fruits of *Apium* occur, but are never well preserved. As a rule the state of preservation of the Umbelliferæ is not satisfactory.

Chærophyllum sylvestre, *Linn.* (Pl. **12.** fig. 64.)

Two or three fruits of this plant have been found at Pakefield.

Œnanthe Lachenalii, *C. C. Gmel.* (Pl. **13.** fig. 65.)

A few damaged fruits have been found at Pakefield. The skeleton photographed is one of the best.

Œnanthe Phellandrium, *Lam.* (Pl. **13.** figs. 66, 67.)

Fruits of this plant are abundant everywhere; but are usually much smaller than recent specimens.

Æthusa Cynapium, *Linn.* (Pl. **13.** figs. 68, 69.)

A few fruits occur at Pakefield.

Pastinaca sativa, *Linn.* (Pl. **13.** fig. 70.)

Occurs at Pakefield and Trimingham.

Heracleum Sphondylium, *Linn.* (Pl. **13.** fig. 71.)

Three specimens seen; all have the obcordate fruit here figured.

Torilis Anthriscus, *Bernh.* (Pl. **13.** fig. 72.)

Two characteristic fruits have been found at Pakefield.

Viburnum Opulus, *Linn.* (Pl. **13.** fig. 74.)

Only two seeds have been found.

Viburnum sp. 2. (Pl. **13.** figs. 75–77.)

At Pakefield about 30 or 40 flat or plano-convex seeds belonging apparently to a second species of *Viburnum* have been found. They are about the size of *V. Tinus*, but in other respects do not agree with that species. The fossil seeds are oval, the ventral face is flat or slightly rounded and channelled, the dorsal face has two ridges which are not quite symmetrical, the testa is very thick. Length 3 mm., breadth 2 mm.

At first, from their general appearance and their slight want of symmetry, these seeds were thought to belong to *Lonicera*; but in that genus the testa

is thin, not exceptionally thick as in our fossil. They appear to belong to Caprifoliaceæ, but we can find no European plant to which they can be referred. Only three species of *Viburnum* now inhabit Europe.

VIBURNUM sp. 3. (Pl. **13**. figs. 78, 79.)

About a dozen large woody seeds found at Pakefield seem to belong to a third species of *Viburnum*. Seed oval, flattened ; ventral face slightly rounded and channelled, dorsal face rounded and obscurely, irregularly ridged longitudinally. Length 7 mm., breadth 5 mm. These seeds obviously belong to the same genus as the last, but are more than double the length. We can find nothing to correspond with them.

Many fossil species of *Viburnum* have been described, but always from leaves. Until we have further material, both recent and fossil, we cannot give a name to the Pakefield specimens.

GALIUM APARINE, *Linn.* (Pl. **13**. fig. 80.)

This plant occurs at Pakefield, but the fruits have entirely lost their outer coat and hooked bristles.

VALERIANA SAMBUCIFOLIA, *Willd.* (Pl. **13**. fig. 81.)

The only fruit of *Valeriana* is so crumpled that it cannot be photographed satisfactorily ; it certainly belongs to this species.

VALERIANELLA OLITORIA, *Poll.* (Pl. **13**. fig. 82.)

One fruit, crushed so as to expose the seed, and a few detached seeds are all that we have seen. The coarse punctation of the seed is very marked, and characteristic of this species.

EUPATORIUM sp.? (Pl. **13**. fig. 83.)

A minute composite fruit with linear shape and five sharp ridges would appear to belong to this genus, but we have not been able to identify it. *Eupatorium cannabinum* has not yet been found in pre-Glacial deposits, though its fruits are not uncommon in newer strata.

TUSSILAGO FARFARA, *Linn.* (Pl. **13**. fig. 85.)

Two or three characteristic fruits have been found at Pakefield.

ARCTIUM sp. (Pl. **13**. figs. 86, 87.)

Two different forms of fruit of *Arctium* have been found ; but we cannot satisfactorily determine them without more recent material.

CARDUUS NUTANS, *Linn.* (Pl. **13**. figs. 88, 89.)

Not uncommon in the Cromer Forest-bed.

CARDUUS, cf. NUTANS, *Linn.* (Pl. **13.** fig. 90.)

Fruits like *C. nutans*, but with finer sculpture and without longitudinal ribs. We find this species occurring also in a deposit of slightly older date at Tegelen in the Netherlands. The Pakefield seeds vary considerably in size, the one figured is large.

Our series of recent fruits of *Carduus* is still very imperfect, and in herbarium specimens the fruits are seldom ripe. The fossil may belong to some well-known continental plant.

CARDUUS PALUSTRIS, *Linn.* (Pl. **13.** fig. 91.)

A few fruits have been found at Pakefield.

CARDUUS LANCEOLATUS, *Willd.* ?

This species has been recorded with doubt ('Origin of the British Flora') but the specimen was badly preserved and we can find no others.

CARDUUS HETEROPHYLLUS, *Linn.* ? (Pl. **13.** fig. 92.)

The coarse rugose sculpture of the fruit figured corresponds so closely with that of *C. heterophyllus*, that we must refer our fossil to that species. We have only one specimen, and this is the only plant at Pakefield that suggests northern rather than southern latitudes.

CENTAUREA sp. (Pl. **13.** figs. 93, 94.)

Two fruits of *Centaurea* have been found at Pakefield, probably representing two species. The fruit shown in fig. 94 corresponds with *C. Calcitrapa*, and with no other British form. But there are so many European species of this genus the fruits of which we have yet been unable to examine, that we hesitate to refer our fossil to a species belonging so markedly to dry soils.

CREPIS SUCCISÆFOLIA, *Tausch.* (Pl. **13.** fig. 96.)

Not uncommon at Pakefield.

LEONTODON AUTUMNALIS, *Linn.* (Pl. **13.** fig. 97.)

Occurs rarely at Pakefield.

VERBASCUM THAPSUS, *Linn.* (Pl. **14.** fig. 102.)

A single seed has been found at Pakefield. The species in this genus are readily distinguished by their seeds.

LIMOSELLA AQUATICA, *Linn.* (Pl. **14.** fig. 103.)

Only one specimen has been found; but the seed is so small that it may easily be overlooked, or lost in washing the clay.

Veronica Chamædrys, *Linn.* (Pl. **14**. fig. 104.)

Seeds of *Veronica* are not uncommon; but are usually decayed in such a curious way that they are not easily recognised. The determinable specimens belong to *V. Chamædrys*, and as yet we can find no trace of our three aquatic species.

Calamintha arvensis, *Lam.* (Pl. **14**. fig. 109.)

Prunella vulgaris, *Linn.* (Pl. **14**. fig. 110.)

A few nutlets of each of these have been found at Pakefield.

Stachys sylvatica, *Linn.* (Pl. **14**. fig. 111.)

Not uncommon. The nutlets previously referred to *S. palustris* belong to this species. We cannot yet find *S. palustris*.

Stachys arvensis, *Linn.* (Pl. **14**. fig. 112.)

Two nutlets from Pakefield show the characteristic rugosity and punctation of this species.

Ballota nigra, *Linn.* (Pl. **14**. fig. 113.)

Rare at Pakefield.

Ajuga reptans, *Linn.* (Pl. **14**. fig. 114.)

The illustration represents the only specimen yet found. It is unfortunately so crushed that it is difficult to show the characters in a photograph. The nutlet shows, however, the enormous aperture and reticulated back characteristic of this species.

Labiatæ, genus undetermined. (Pl. **14**. fig. 115.)

Nutlets ovate, rounded above, sharp below, with a very sharp prominent ventral ridge; sculpture of fine, very regular punctation (thimble-pitting), without rugosity or tubercles. Length 1·6 mm., breadth 1·0 mm.

This belongs to no British plant. We have few fruits of foreign labiates to compare with it, and only unripe nutlets are usually to be found in herbaria.

Labiatæ, genus undetermined. (Pl. **14**. fig. 116.)

Nutlet broad, very tumid and rugose, with sharp ventral ridge. Length 1·8 mm., breadth 1·25 mm.

This also belongs to no living British plant; but we have found a similar nutlet in a somewhat older deposit at Tegelen in the Netherlands.

Littorella juncea, *Berg.* (Pl. **14**. fig. 117.)

Two fruits only have been found, but they correspond exactly with those of the recent plant.

Chenopodium album, *Linn.* (Pl. **14**. fig. 118.)

C. rubrum, *Linn.* (Pl. **14**. fig. 119.)

Call for no remark; they correspond with recent seeds.

Atriplex hastata, *Linn.* (Pl. **14**. fig. 120.)

After examining a number of specimens we have come to the conclusion that the seeds previously referred to *A. patula* must all be referred to this species; but we can only find seeds of one size.

Polygonum Convolvulus, *Linn.* (Pl. **14**. fig. 121.)

A single nut with part of the perianth has been found at Pakefield.

Polygonum aviculare, *Linn.* (Pl. **14**. fig. 122.)

A few nuts have been found; the one figured has part of the perianth attached.

Polygonum Persicaria, *Linn.* (Pl. **14**. fig. 123.)

Nuts somewhat smaller than our recent specimens, but otherwise correspond.

Polygonum amphibium, *Linn.* (Pl. **14**. fig. 124.)

Agrees exactly.

Rumex maritimus, *Linn.* (Pl. **14**. figs. 125, 126.)

Abundant and somewhat variable. Two forms are figured.

Rumex obtusifolius, *Linn.* (Pl. **14**. fig. 127.)

Shows the characteristic venation of the fruiting sepals.

Rumex Hydrolapathum, *Huds.* (Pl. **14**. fig. 128.)

A very large nut with remains of the fruiting sepals can only be referred to this species.

Rumex acutus, *Linn.*? (Pl. **14**. fig. 129.)

A specimen showing fruiting-perianth with no tubercle, without nut, seems very close to *Rumex acutus.* The venation does not correspond with either *R. crispus* or *R. obtusifolius.*

Rumex Acetosella, *Linn.* (Pl. **14**. fig. 130.)

A nut in skeleton fruiting-perianth, showing the characteristic venation.

Ulmus montana, *Stokes*?

Leaves have been found in the ironstone of Happisburgh; but we cannot get a satisfactory photograph.

URTICA DIOICA, *Linn.* (Pl. **14**. fig. 132.)
U. URENS, *Linn.*? (Pl. **14**. fig. 133.)

These two species are not uncommon; but the sculpture of the nut referred to *U. urens* differs slightly from our recent specimens.

ALNUS GLUTINOSA, *Gaertn.* (Pl. **14**. figs. 135, 136.)
A. sp. (Pl. **14**. figs. 137, 138.)

Cones and seeds of alder are very abundant and generally belong to *A. glutinosa*. At Pakefield there appears to be a second species, the seeds of which have a narrow somewhat stipitate base, and always differ somewhat in colour from the seeds of *Alnus glutinosa* with which they are mixed. We can find no recent alder to correspond with this. The cones are not sufficiently well preserved for us to distinguish them.

SAGITTARIA SAGITTIFOLIA, *Linn.* (Pl. **15**. fig. 152.)

A few carpels have been found, but none are well preserved.

POTAMOGETON NATANS, *Linn.* (Pl. **15**. fig. 153.)
P. PERFOLIATUS, *Linn.* (Pl. **15**. fig. 156.)
P. OBTUSIFOLIUS, *Mert. & Koch.* (Pl. **15**. fig. 159.)
P. PUSILLUS, *Linn.* (Pl. **15**. fig. 160.)

Fruits of *Potamogeton* are extremely abundant at nearly all localities; but the species vary from place to place. Thanks to Mr. James Groves we have been able to compare our fossils with a good series of recent fruits, and now make four additions to the list. One species previously recorded (*P. lucens*) must, however, be deleted as a wrong determination.

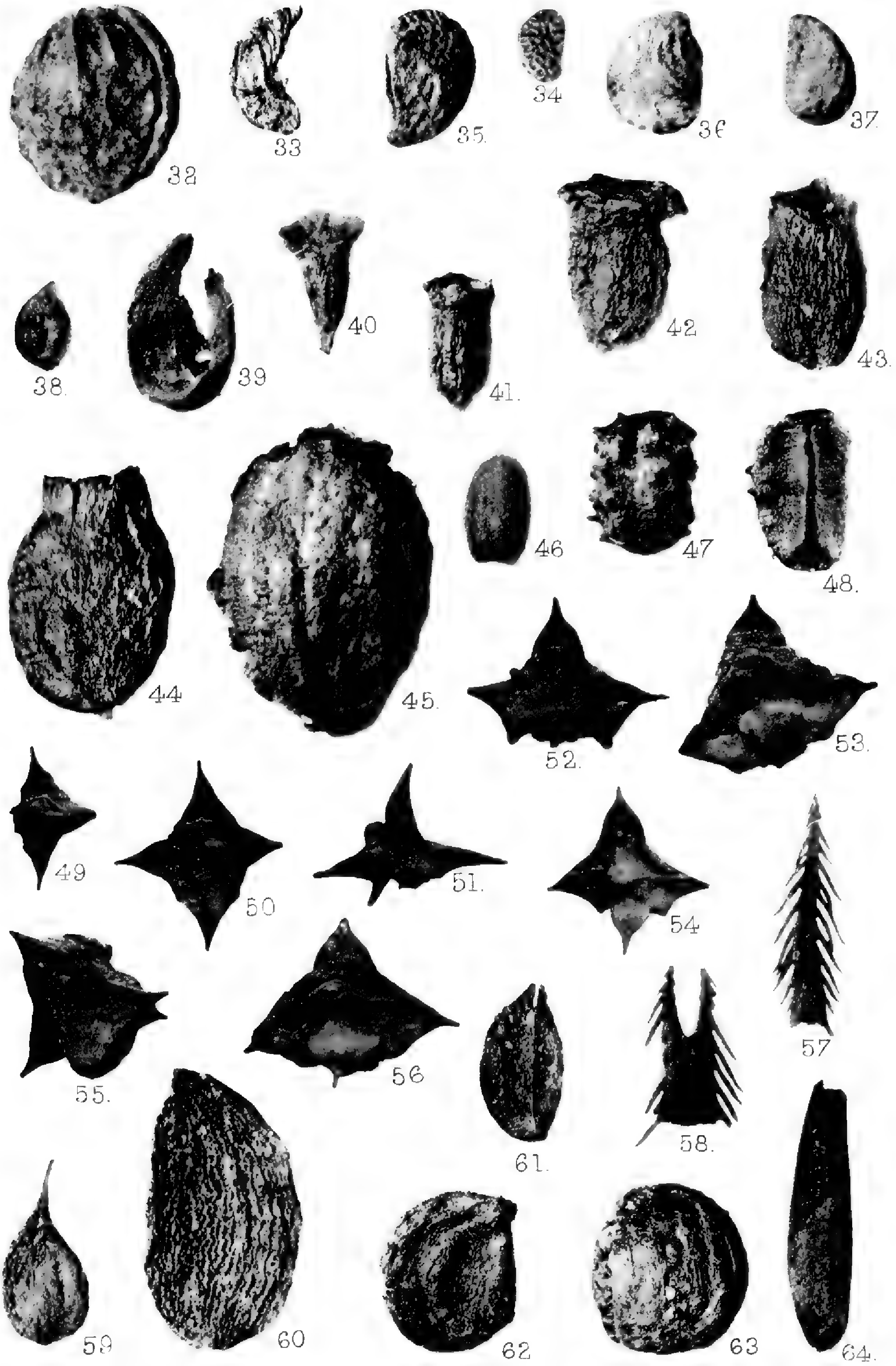
CYPERACEÆ.

Many species of Cyperaceæ are found, but most of them are only represented by detached nuts without setæ or utricles. We have only ventured to determine a few of the best preserved and most characteristic forms.

A few plants previously recorded are not included in the above list and notes, and have been omitted till they can be verified. The determinations may have been right; but in some cases the seeds have suffered so much, from gradual decay of the pyrites, that we cannot now say whether they were right or wrong. In other cases we await more material before authenticating the determination. *Pinus montana*, for instance, has been recorded by Heer and Saporta; but we can find no cones belonging to this pine, though we have examined a large amount of material. Possibly the cones came from a later deposit, with Arctic plants, which overlies the Cromer Forest-bed, and is not included within the scope of this paper.

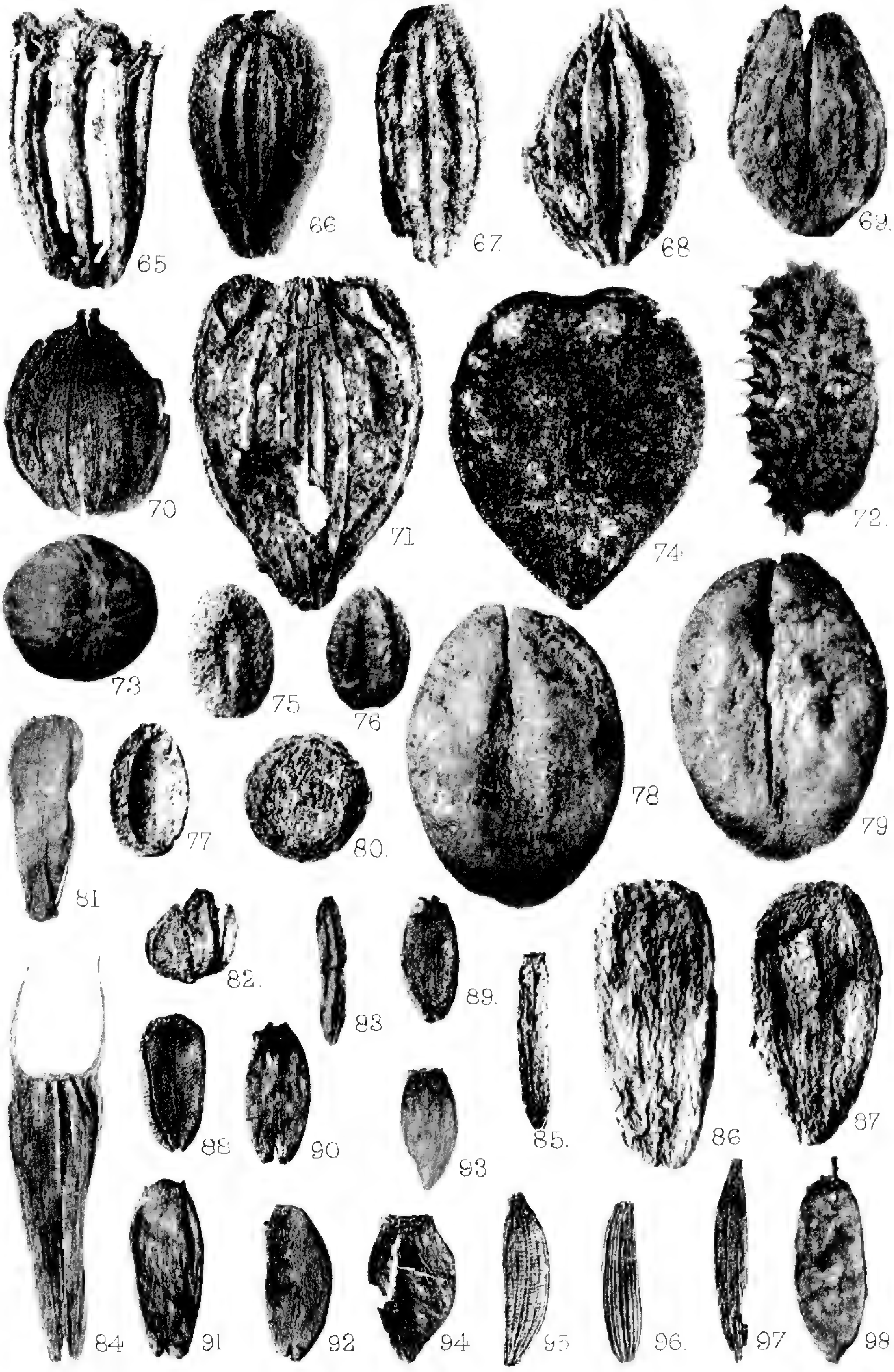
C. & E. M. Reid, photo. London Stereoscopic Co. imp.

THE PRE-GLACIAL FLORA OF BRITAIN



C. & E. M. Reid, photo London Stereoscopic Co. imp

THE PRE-GLACIAL FLORA OF BRITAIN.



C. & E. M. Reid, photo London Stereoscopic Co. imp.

THE PRE-GLACIAL FLORA OF BRITAIN.

C. & E. M. Reid, photo. London Stereoscopic Co. imp.

THE PRE-GLACIAL FLORA OF BRITAIN.

General Conclusions.

This revision nearly doubles the number of plants recorded from British pre-Glacial deposits, for it includes 147 species. We have also various seeds and fruits in a perfectly determinable state, but belonging either to extinct forms, or more probably in the main to British or exotic species not represented in our recent collection. The determination of these is a very slow process ; for a seed so peculiarly sculptured as to be readily determinable, if we happen to know the recent form, may be so wanting in generic or broader characters as to give no clue to guide us in our search. We have not thought it advisable to figure these *incertæ sedis*, unless we could make a definite suggestion as to the families or genera to which they belong, or could draw up a clear botanical description. This is often impossible without destroying a unique specimen in order to examine its internal characters.

The mention of internal characters as applied to specimens of which nothing now remains but the testa or endocarp may seem absurd. It must not be forgotten, however, that in botany, as in zoology, soft parts impress their forms on indestructible hard parts, and convolutions of the embryo or vascular markings may be as well studied from the inside of the testa as in the interior of the skull of some extinct race of man. The illustration of the interior of the fruit of *Ceratophyllum demersum* (Pl. **14**. fig. 143) will indicate how perfect may be this preservation.

Our pre-Glacial flora is found in a series of alluvial and estuarine deposits, which underlie the boulder-clay and stretch for nearly fifty miles along the Norfolk and Suffolk coasts, from Sherringham to Pakefield. The deposits consist of estuarine muds and gravels, apparently brought down by the Rhine, which at that period, after receiving numerous large tributaries—now separate rivers—seems to have flowed across the present bed of the North Sea. It probably entered the sea somewhere near Cromer. Unfortunately the estuarine deposits are very stony, contain ferruginous concretions, and show few drift fruits ; they have therefore not yet been properly examined for plants. It is in these, if anywhere, that we should expect to discover the dry-soil exotic forms lately found higher up the Rhine, at Tegelen, in Limburg. At that place an ancient Rhine alluvium, somewhat older than the Cromer Forest-bed, contains a large flora, the plants showing drier conditions and slightly more southern affinities. The Tegelen list includes *Magnolia Kobus*, *Juglans*, *Pterocarya caucasica*, *Vitis vinifera*, several South European plants, and new species of *Euryale* and *Stratiotes*. It also contains a number of dry-soil North European plants, which help to complete the imperfect picture of the pre-Glacial flora left by our British fossils *.

The plants of our British pre-Glacial deposits, unfortunately, have been collected almost exclusively from the alluvium of small tributary channels,

* The Tegelen flora has been described by us in a communication sent to the Academy of Sciences at Amsterdam : Versl. K. Akad. Wetens. 2e Sect. xiii. n. 6 (1907).

not from the alluvium of the main river. These small stream-channels necessarily yield in the main the plants that lived in them, or grew on the adjoining wet meadows, or in moist woods not far away. A few winged seeds dropped in and others were brought by birds ; but though the dry-soil element is gradually being discovered, it is only represented by perhaps one seed out of a hundred, the bulk of the specimens belonging to a few aquatic genera. This scarcity of dry-soil plants makes our pre-Glacial list at present a poor representation of the ancient British flora. We can only compare it with the plants now living in or around a Norfolk Broad and those that accidentally drift in.

Perhaps the first thing to strike a botanist on examining our list will be, how little the flora has altered in the many thousand years that have elapsed and during the various climatic changes that have intervened. It was driven out by the cold of the Glacial Epoch and came back little altered.

But closer study somewhat modifies these conclusions, for a good many exotic species occur, and it must be remembered that several if not most of the *incertæ sedis* will almost certainly be exotic also. The non-British forms now recorded are *Ranunculus nemorosus*, two other species of *Ranunculus*, one or perhaps two water-lilies, *Hypecoum procumbens*, *Trapa natans*, two species of *Viburnum* ?, two labiates, a second species of alder, *Picea excelsa*, and *Najas minor*. These give a decidedly peculiar appearance to the flora.

It is not very safe to deal with negative evidence, but there is another peculiarity in this fossil flora that only those who have handled a large amount of material will notice. A number of our plants have seeds and fruits so soft or decaying so readily that they seem never to be preserved in the fossil state. Such are *Ranunculus Ficaria*, most of the crucifers, leguminosæ, and many umbellifers and grasses ; these we cannot expect to find save under very exceptional conditions. Certain of our common meadow and woodland plants, which we know, from the examination of more modern deposits, have seeds which preserve perfectly and abundantly, are, on the other hand, still missing in our pre-Glacial list. Disregarding plants which we find in deposits of Roman date, but no earlier, for these may be weeds of cultivation, we notice the absence of *Ranunculus acris*, *R. bulbosus*, *Lychnis Flos-cuculi*, *Potentilla palustris*, *Sambucus nigra*, *Taraxacum*, *Sonchus*, *Lamium*. The hazel, so abundant in our Neolithic submerged forests, is only represented in the Cromer Forest-bed by a few nuts, usually stunted and distorted in growth.

The pre-Glacial plants suggest climatic conditions almost identical with those now existing, though slightly warmer. This difference, however, may be largely due to the connection of Britain with the Continent while the plant-bed was forming. The influence of altered geographical conditions on our living fauna and flora has already been discussed (*op. cit.*) and need not be further commented on. Nothing in the present revision has tended to modify the conclusions already arrived at, except that the southern element

in the flora is becoming more marked. Also, it now appears that it includes in all probability several extinct species. This brings it more into line with the pre-Glacial mammals and mollusca, both of which groups contain various extinct forms.

EXPLANATION OF THE PLATES.

Plate 11.

Fig. 1. *Thalictrum flavum*, Linn., carpel, $\frac{12}{1}$. Pakefield.

2, 3. *Ranunculus aquatilis*, Linn., carpels, $\frac{12}{1}$. Pakefield.

4. *R. sceleratus*, Linn., carpel, $\frac{12}{1}$. Pakefield.

5. *R. Flammula*, Linn., carpel, $\frac{12}{1}$. Pakefield.

6. *R. Lingua*, Linn., carpel, $\frac{12}{1}$. Beeston.

7. *R. repens*, Linn., carpel, $\frac{12}{1}$. Pakefield.

8. *R. nemorosus*, DC., carpel, $\frac{12}{1}$. Pakefield.

9. *R.* sp. 7, carpel, $\frac{12}{1}$. Beeston.

10. *R.* sp. 8, carpel, $\frac{12}{1}$. Pakefield.

11. *Caltha palustris*, Linn., short seeds, $\frac{12}{1}$. Pakefield.

12. —— long seed, $\frac{12}{1}$. Mundesley.

13. *Nymphæa lutea*, Linn., seed, $\frac{6}{1}$. Pakefield.

14. *Castalia alba*, Woods, seed, $\frac{6}{1}$. Pakefield.

15. Undetermined species belonging to Nymphæaceæ, seed, $\frac{6}{1}$. Pakefield.

16. Another undetermined species belonging to Nymphæaceæ, seed, $\frac{12}{1}$. Pakefield.

17. *Hypecoum procumbens*, Linn., seed, $\frac{12}{1}$. Corton.

18. *Viola palustris*, Linn., seed, $\frac{12}{1}$. Pakefield.

19, 20. *V.* cf. *hirta*, Linn., seed, $\frac{12}{1}$. Pakefield.

21. *V.* cf. *Riviniana*, Reichb., seed, $\frac{12}{1}$. Pakefield.

22. *Stellaria aquatica*, Moench, seed, $\frac{12}{1}$. Pakefield.

23. *S. media*, Villars, seed, $\frac{12}{1}$. Pakefield.

24. *S. Holostea*, Linn., seed, $\frac{12}{1}$. Pakefield.

25. *Arenaria serpyllifolia*, Linn., seed, $\frac{12}{1}$. Pakefield.

26. *Elatine Hydropiper*, Linn., seed, $\frac{24}{1}$. Pakefield.

27. *Hypericum quadrangulum*, Linn., seed, $\frac{24}{1}$. Pakefield.

28. *H. hirsutum*, Linn., seed, $\frac{24}{1}$. Pakefield.

29. *Rhamnus Frangula*, Linn., seed, $\frac{6}{1}$. Pakefield.

30. *Acer campestre*, Linn., fruit wanting wing, $\frac{3}{1}$. Pakefield.

31. —— part of wing, $\frac{3}{1}$. Pakefield.

Plate 12.

Fig. 32. *Prunus spinosa*, Linn., nut, $\frac{3}{1}$. West Runton.

33. *Spiræa Ulmaria*, Linn., seed, $\frac{6}{1}$. Pakefield.

34. *Rubus Idæus*, Linn., seed. $\frac{6}{1}$. Pakefield.

35. *R. fruticosus*, Linn., seed, $\frac{6}{1}$. Pakefield.

36, 37. *Potentilla silvestris*, Neck., nuts, $\frac{12}{1}$. Mundesley and Pakefield.

38. *Alchemilla arvensis*, Scop., nut, $\frac{12}{1}$. Pakefield.

39. *Pyrus Malus*, Linn., seed, $\frac{6}{1}$. Pakefield.

40–44. *Cratægus Oxyacantha*, Linn., series showing variation in form at one locality, nuts, $\frac{6}{1}$. Overstrand.

45. *Cratægus* sp.?, nut, $\frac{6}{1}$. Pakefield.

46. *Hippurus vulgaris*, Linn., fruit, $\frac{12}{1}$. Pakefield.

47, 48. *Myriophyllum spicatum*, Linn., nuts, $\frac{12}{1}$. Pakefield.

49–56. *Trapa natans*, Linn., nuts, $\frac{1}{1}$. Mundesley.

57, 58. —— spine and abnormal spine, $\frac{6}{1}$. Pakefield.

59. *Circæa lutetiana*, Linn., fruit, $\frac{6}{1}$. Pakefield.

60. *Conium maculatum*, Linn., carpel, $\frac{12}{1}$. Pakefield.

61. *Apium* sp., carpel, $\frac{12}{1}$. Pakefield.

62, 63. *Cicuta virosa*, Linn., carpels, $\frac{12}{1}$. Pakefield and Beeston.

64. *Chærophyllum sylvestre*, Linn., carpel, $\frac{6}{1}$. Pakefield.

Plate 13.

Fig. 65. *Œnanthe Lachenalii*, C. C. Gmel., skeleton carpel, $\frac{12}{1}$. Pakefield.

66. *Œ. Phellandrium*, Lam., carpel, ventral face, $\frac{12}{1}$. Pakefield.

67. —— carpel, dorsal face, $\frac{12}{1}$. Pakefield.

68. *Æthusa Cynapium*, Linn., carpel, dorsal face, $\frac{12}{1}$. Pakefield.

69. —— carpel, ventral face, $\frac{12}{1}$. Pakefield.

70. *Pastinaca sativa*, Linn., carpel, $\frac{6}{1}$. Pakefield.

71. *Heracleum Sphondylium*, Linn., carpel, $\frac{6}{1}$. Pakefield.

72. *Torilis Anthriscus*, Bernh., carpel, $\frac{12}{1}$. Pakefield.

73. *Cornus sanguinea*, Linn., nut, $\frac{6}{1}$. Pakefield.

74. *Viburnum Opulus*, Linn., seed, $\frac{6}{1}$. Pakefield.

75. *V.* ? sp. 2, seed, ventral surface, $\frac{6}{1}$. Pakefield.

76. *V.* ? sp. 2, seed, dorsal surface, $\frac{6}{1}$. Pakefield.

Fig. 77. *Viburnum* ? sp. 2, seed, inside, $\frac{6}{1}$. Pakefield.

78. *V.* ? sp. 3, seed, ventral surface, $\frac{6}{1}$. Pakefield.

79. *V.* ? sp. 3, seed, dorsal surface, $\frac{6}{1}$. Pakefield.

80. *Galium Aparine*, Linn., fruit, wanting bristles, $\frac{6}{1}$. Pakefield.

81. *Valeriana sambucifolia*, Willd., fruit, $\frac{6}{1}$. Pakefield.

82. *Valerianella olitoria*, Poll., fruit, burst so as to show seed, $\frac{6}{1}$. Pakefield.

83. *Eupatorium* sp.?, fruit, $\frac{12}{1}$. Pakefield.

84. *Bidens tripartita*, Linn., fruit, $\frac{6}{1}$. Pakefield.

85. *Tussilago Farfara*, Linn., fruit, $\frac{6}{1}$. Pakefield.

86, 87. *Arctium* sp., fruits, $\frac{6}{1}$. Pakefield.

88, 89. *Carduus nutans*, Linn., fruits, $\frac{6}{1}$. Pakefield.

90. *C.* cf. *nutans*, Linn., fruit, $\frac{6}{1}$. Pakefield.

91. *C. palustris*, Linn., fruit, $\frac{6}{1}$. Pakefield.

92. *C. heterophyllus*, Linn.?, fruit, $\frac{6}{1}$. Pakefield.

93. *Centaurea* sp., fruit, $\frac{6}{1}$. Pakefield.

94. *C. Calcitrapa*, Linn.?, fruit, $\frac{6}{1}$. Pakefield.

95. *Picris hieracioides*, Linn., fruit, $\frac{6}{1}$. Pakefield.

96. *Crepis succisæfolia*, Tausch, fruit, $\frac{6}{1}$. Pakefield.

97. *Leontodon autumnalis*, Linn., fruit, $\frac{6}{1}$. Pakefield.

98. Undetermined Composite?, $\frac{24}{1}$. Pakefield.

Plate 14.

Fig. 99. *Menyanthes trifoliata*, Linn., seed, $\frac{12}{1}$. Pakefield.

100, 101. *Solanum Dulcamara*, Linn., seeds, $\frac{12}{1}$. Pakefield. (Fig. 101 is mounted in glycerine jelly, to bring out cell-structure.)

102. *Verbascum Thapsus*, Linn., seed, $\frac{12}{1}$. Pakefield.

103. *Limosella aquatica*, Linn., seed, $\frac{24}{1}$. Pakefield.

104. *Veronica Chamædrys*, Linn., seed, $\frac{12}{1}$. Pakefield.

105, 106. *Mentha aquatica*, Linn., nutlets (dorsal and ventral faces), $\frac{12}{1}$. Pakefield.

107, 108. *Lycopus europæus*, Linn., nutlets (dorsal and ventral faces), $\frac{12}{1}$. Pakefield.

109. *Calamintha arvensis*, Lam., nutlet (ventral face), $\frac{12}{1}$. Pakefield.

110. *Prunella vulgaris*, Linn., nutlet (ventral face), $\frac{12}{1}$. Pakefield.

111. *Stachys sylvatica*, Linn., nutlet (ventral face), $\frac{12}{1}$. Pakefield.

Fig. 112. *Stachys arvensis*, Linn., nutlet (ventral face), $\frac{12}{1}$. Pakefield.

113. *Ballota nigra*, Linn., nutlet (dorsal face), $\frac{12}{1}$. Pakefield.

114. *Ajuga reptans*, Linn., nutlet (ventral face), $\frac{12}{1}$. Pakefield.

115. Undetermined labiate, nutlet (ventral face), $\frac{12}{1}$. Pakefield.

116. Another undetermined labiate, nutlet (dorsal face), $\frac{12}{1}$. Pakefield.

117. *Littorella juncea*, Berg., fruit, $\frac{12}{1}$. Pakefield.

118. *Chenopodium album*, Linn., seed, $\frac{12}{1}$. Beeston.

119. *C. rubrum*, Linn., seed, $\frac{12}{1}$. Pakefield.

120. *Atriplex hastata*, Linn. ?, seed, $\frac{12}{1}$. Pakefield.

121. *Polygonum Convolvulus*, Linn., nut with part of perianth, $\frac{6}{1}$. Pakefield.

122. *Polygonum aviculare*, Linn., nut with trace of perianth, $\frac{6}{1}$. Pakefield.

123. *P. Persicaria*, Linn., nut, $\frac{6}{1}$. Pakefield.

124. *P. amphibium*, Linn., nut, $\frac{12}{1}$. Mundesley.

125, 126. *Rumex maritimus*, Linn., fruits, $\frac{6}{1}$. Pakefield.

127. *R. obtusifolius*, Linn., fruit, $\frac{6}{1}$. Pakefield.

128. *R. Hydrolapathum*, Huds., fruit, $\frac{6}{1}$. Pakefield.

129. *R. acutus*, Linn. ?, fruit, $\frac{6}{1}$. Pakefield.

130. *R. Acetosella*, Linn., fruit, $\frac{6}{1}$. Beeston.

131. *Euphorbia amygdaloides*, Linn., seed, $\frac{12}{1}$. Pakefield.

132. *Urtica dioica*, Linn., nut, $\frac{12}{1}$. Pakefield.

133. *U. urens*, Linn. ?, nut, $\frac{12}{1}$. Pakefield.

134. *Betula alba*, Linn., fruit showing part of wing, $\frac{12}{1}$. Pakefield.

135. *Alnus glutinosa*, Gaertn., seed, $\frac{6}{1}$. Pakefield.

136. —— cone, $\frac{2}{1}$. Pakefield.

137, 138. *Alnus* sp., seeds, $\frac{6}{1}$. Pakefield.

139, 140. *Carpinus Betulus*, Linn., nuts (ventral and dorsal faces), $\frac{3}{1}$. Pakefield.

141. *Corylus Avellana*, Linn., nut, $\frac{1}{1}$. Pakefield.

142. *Quercus Robur*, Linn., acorn-cup, $\frac{1}{1}$. Happisburgh.

143. *Ceratophyllum demersum*, Linn., fruit, inside, $\frac{3}{1}$. Pakefield.

144. —— fruit, outside, $\frac{3}{1}$. Pakefield.

Plate 15.

Fig. 145. *Taxus baccata*, Linn., seed, $\frac{3}{1}$. Happisburgh.

146. *Pinus sylvestris*, Linn., cone, $\frac{1}{1}$. Cromer.

C. & E. M. Reid, photo

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THE PRE-GLACIAL FLORA OF BRITAIN.

Fig. 147. *Picea excelsa*, Link, cone, $\frac{1}{1}$. Mundesley.

148. *Stratiotes Aloides*, Linn., seed, inside, $\frac{3}{1}$. Beeston.

149. —— seed, outside, $\frac{3}{1}$. Pakefield.

150. *Sparganium erectum*, Linn. ?, nut, $\frac{6}{1}$. Pakefield.

151. *Alisma Plantago*, Linn., carpel, $\frac{12}{1}$. Mundesley.

152. *Sagittaria sagittifolia*, Linn., carpel, $\frac{12}{1}$. Pakefield.

153. *Potamogeton natans*, Linn., nut, $\frac{6}{1}$. Overstrand.

154. *P. heterophyllus*, Schreb., nut, $\frac{6}{1}$. Cromer.

155. *P. prælongus*, Wulf., nut, $\frac{6}{1}$. Cromer.

156. *P. perfoliatus*, Linn., carpel, $\frac{6}{1}$. Mundesley.

157. *P. crispus*, Linn., carpel, $\frac{6}{1}$. Pakefield.

158. —— nut, $\frac{6}{1}$. Beeston.

159. *P. obtusifolius*, Mert. & Koch, nut, $\frac{6}{1}$. Mundesley.

160. *P. pusillus*, Linn., nut, $\frac{6}{1}$. Pakefield.

161. *P. trichoides*, Cham., nut, $\frac{6}{1}$. Sidestrand.

162. *P. pectinatus*, Linn., carpel, $\frac{6}{1}$. Pakefield.

163. *Zannichellia palustris*, Linn., carpel, $\frac{12}{1}$. Pakefield.

164. *Z. pedunculata*, Reichb., carpel, $\frac{12}{1}$. Pakefield.

165. *Najas marina*, Linn., fruit, outside, $\frac{6}{1}$. Pakefield.

166. —— fruit, inside, $\frac{6}{1}$. Pakefield.

167. *N. minor*, Allioni, fruit, $\frac{12}{1}$. Pakefield.

168. *Eleocharis* sp., nut, $\frac{12}{1}$. Beeston.

169. *Scirpus fluitans*, Linn., nut, $\frac{12}{1}$. Beeston.

170. *S. lacustris*, Linn., nut, $\frac{12}{1}$. Pakefield.

171. *S. Tabernæmontani*, C. C. Gmel., nut, $\frac{12}{1}$. Mundesley.

172. *Carex dioica*, Linn., fruit, $\frac{6}{1}$. Corton.

173. *C. muricata*, Linn., nut, $\frac{12}{1}$. Pakefield.

174. *C.* cf. *helodes*, Link, fruit, $\frac{6}{1}$. Pakefield.

175. *C. hirta*, Linn., fruit, $\frac{6}{1}$. Pakefield.

176. *C. acutiformis*, Ehrh., fruit, $\frac{6}{1}$. Pakefield.

177. *C. riparia*, Curtis, fruit, $\frac{6}{1}$. Pakefield.

178. *C. rostrata*, Stokes, nut, $\frac{12}{1}$. Pakefield.

179. *C. vesicaria*, Linn., fruit, $\frac{6}{1}$. Corton.

180. *C.* sp. 9, nut, $\frac{12}{1}$. Pakefield.

181. *C.* sp. ?, fruit, $\frac{12}{1}$. Corton.

An Account of the Plants collected on Mt. Ruwenzori by Dr. A. G. F. Wollaston. By Dr. A. B. Rendle, M.A., F.L.S., E. G. Baker, F.L.S., and S. Le M. Moore, B.Sc., F.L.S.

(Plates 16–19.)

[Read 20th June, 1907.]

The plants enumerated were collected by Dr. A. G. F. Wollaston on the recent expedition to Mt. Ruwenzori conducted by Mr. R. B. Woosnam, for the purpose of making natural history collections; these collections are now at the British Museum. Dr. Wollaston reached a height of over 15,000 ft., on one of the peaks which has been named in his honour by the Duke of Abruzzi. A geographical account of the mountain-range known as Mt. Ruwenzori, with an excellent map, will be found in the Duke of Abruzzi's paper entitled the "Snows of the Nile" in the Geographical Journal, xxix. (1907) pp. 121–147.

Previous Collectors.

Mt. Ruwenzori was discovered by Sir Henry Stanley, who saw the mountain to the south from Lake Albert Edward in 1888 and in the following year traversed its western slopes; one of his companions, Lieut. Stairs, climbed to a height of 10,700 ft. on its north-western spurs and collected 38 plants, of which the generic names are enumerated on p. 258 of H. M. Stanley's 'In Darkest Africa.' The first botanical collection of any extent made on the Mt. Ruwenzori range was that of Dr. Stuhlmann in 1891. He ascended the valley of the Butagu on the west of the chain to a height of 13,300 feet. Mr. G. F. Scott Elliot in 1895 made five excursions towards the central ridge, approaching it on the east by the valleys of Yeria, Wimi, Mobuku, and Nyamwamba, and on the west from the Butagu valley. In the last he reached 13,000 ft. Later Sir H. Johnston reached a height of about 15,000 ft. on the east slopes of the peak which he named Kiyanga. On this expedition some plants were collected by Mr. Doggett and presented to the Royal Gardens, Kew. Several of these are identical with Dr. Wollaston's plants. In 1906 the Duke of Abruzzi led the successful expedition on which so many of the different peaks were scaled for the first time. He was accompanied by Dr. Roccati as collector. Collections have also been recently made by Mr. Dawe, of the Botanic Gardens at Entebbe.

Notes on the Vegetation.

We are indebted to Dr. Wollaston's notes for information on the types of vegetation at various altitudes; we have added a general account of the results obtained in working out his collections. The plants were mainly collected from two camps: one at about 3500 ft. altitude on the south-east slopes of the range, between the mountains proper and Lake Ruisamba; the other at an altitude of 6500 feet in the Mubuku valley, the most important valley on the east side of the range. Expeditions were made to intermediate

and higher altitudes, the highest camp being at about 12,500 ft., whence plants were collected to the snow-level, which may roughly be said to be at 14,500 ft. on the east side of the mountains. The time of year was from January to July : January was a month of fine weather ; February, March and April were very wet in the mountains. From the middle of April, when a move was made to the lower camp near Lake Ruisamba, the weather was almost continuously fine. Most of the flowering plants had ceased to blossom by the end of May, and butterflies, which were exceedingly abundant during the latter part of April and May, were almost absent from the lower slopes in June.

The following is a brief summary of the general aspect of the country and the more striking forms of the vegetation seen at various altitudes.

It will be seen that the present collections illustrate the botany only of a restricted portion of this great mountain-range, confined to Mt. Kyanga (recently named Mt. Baker by the Duke of Abruzzi) and the valleys leading up to it. It remains for future explorers to provide means for the study of the botany of the other large mountains to the north and west.

3000–4000 feet. Beyond the wide belt of papyrus and swamp, which surrounds Lake Ruisamba, is a park-like country of shortish grass with scattered trees, mostly acacias, and intersected by deep ravines, in which is found a thick jungle of two species of fleshy euphorbia, a large-leaved fig (*Spathodea campanulata*) with magnificent clusters of scarlet flowers, a tangle of vines and asclepiads and a conspicuous white sweet-scented jasmine (*Jasminum Schimperi*). Two species of epiphytic orchids were found in these jungles.

The plants collected include a number of wide-spread tropical species, such as *Sida spinosa*, *Hibiscus cannabinus* and *H. micranthus*, *Melia Azedarach*, *Desmodium lasiocarpum*, *Cassia mimosoides*, *Evolvulus alsinoides*, *Plumbago zeylanica*, *Ipomœa calycina*, *Amaranthus caudatus*, *Euphorbia hypericifolia* and *Panicum pileatum*; *Acacia Catechu* and *Ipomœa Wightii* are of eastern affinity, occurring in tropical Asia but not passing into west tropical Africa. Others are more or less widely spread tropical African or tropical South African species, as *Pavonia macrophylla*, *Corchorus trilocularis*, *Vernonia cinerascens*, *Craterostigma plantagineum*, *Striga hermonthica*, *Sopubia ramosa*, *Ruellia patula*, *Celosia trigyna*, and *Ornithogalum Eckloni*. Other species are east tropical African, such as *Grewia similis* (at 4000 ft.) and *Hibiscus æthiopicus* (also South African), while *Hibiscus crassinervis*, *Turræa nilotica*, *Helinus mystacinus*, *Jasminum Schimperi* (Abyssinia), *Barleria Grantii*, are more northern "Nile Land" types, and *Mellera lobulata*, *Adhatoda Engleriana*, *Lissochilus Livingstonianus* of more southerly distribution (Uganda, the Mozambique district and British Central Africa). A western affinity is represented by *Spathodea campanulata*, a west tropical African species which finds the eastern limit of its distribution on Mt. Ruwenzori, *Thunbergia*

fasciculata, a Cameroons plant, and *Mucuna Poggei* (found at 4000 ft.). *Schizoglossum eximium* is restricted to Ruwenzori; and the following are new species: *Aloe Wollastoni*, *Chlorophytum ruwenzoriensis*, and *Baphia Wollastoni* (at 4000 ft.), allied to the West African *B. angolensis*.

4000–5000 feet. About this level there is a good deal of native cultivation, chiefly bananas, manioc, indian corn and beans. At this altitude the huge "elephant-grass" growing from 10 to 15 feet high is the most important feature of the vegetation, and conspicuous among it are the pretty little trees of *Erythrina tomentosa* with tufts of crimson flowers.

The following were collected at 5000 ft.:—*Tephrosia paniculata* (Angola and Uganda); *Fleurya podocarpa*, a widely spread tropical African species; *Crinum scabrum*, a more northern type (Abyssinia and the Nile Valley); and a new composite, *Guizotia collina*.

5000–6000 feet. Cultivation and elephant-grass still continue, with species of *Ipomœa* climbing about the stems of the grass, and the very handsome red-and-yellow *Gloriosa virescens* (var. *splendens*, var. nov.), which is found up to 7000 ft. A few small patches of forest with a good many ferns, polypodiums and others fill the bottom of the valley at this level.

The plants collected at 6000 ft. include some widely distributed tropical species, such as *Vigna luteola*, *Psophocarpus palustris*, *Ageratum conyzoides* and other composites, with a new variety of *Laggera alata*, a common tropical African and Asiatic species; some widely spread tropical African species, such as *Desmodium Scalpe* (also India), *Pentas purpurea*, *Melanthera Brownei* (also South Africa), *Platystoma africanum* (also India), *Cyathula cylindrica* (also S. Africa and Madagascar), and *Crinum giganteum*. A marked east tropical affinity is shown by *Eriosema montanum*, *Rhamphicarpa Herzfeldiana*, *Osbeckia densiflora* (Mozambique), *Helichrysum fœtidum*, *Sonchus Bipontini* var., and *Indigofera longebarbata* (Abyssinia); *Brillantaisia patula* is a Cameroons plant also found in Uganda. *Streptocarpus ruwenzoriensis* (also in Usambara), *Isoglossa runssorica*, *Triumfetta ruwenzoriensis* and *Gynura ruwenzoriensis*, the two latter also collected at 7000 ft., represent an endemic distribution; and the following are novelties: *Thunbergia oculata*, *Coleus gracilentus*, and *Pentas pubiflora*; a variety of the last occurs at 7000 ft.

6000–7000 feet. The banana is not cultivated much above 6000 ft. and the elephant-grass ceases at the same level. Above this is a zone of shrubs, conspicuous amongst them being *Acanthus arboreus* with mauve flowers, two or three yellow-flowered Papilionaceæ and a handsome *Solanum* with prickly leaves and a large yellow fruit. The first of the tree-lobelias (*L. Giberroa*) is found in the open places on sunny slopes. Wild bananas are found in shady places up to 7000 feet and beyond. Dracænas, reaching a height of thirty feet and upwards, are found in groups beside the streams. Millet and colocasia are cultivated up to 7000 ft., above which level cultivation ceases. A large number of species was collected at 7000 ft., the majority of which are

more or less widely distributed in the highlands of tropical Africa. Of these a minority occur on both sides of the continent; such are:—*Ranunculus membranaceus* (Abyssinia, Kilimanjaro, Zambesi Highlands and Huilla), *Pavonia Schimperiana* (Abyssinia to Cameroons and Angola), *Kosteletzkya adoensis* (Abyssinia to Nyasaland and Cameroons), *Cassia didymobotrya* (east Africa and Angola), *Discopodium penninervium* (Uganda and Nyasaland and Cameroons), *Micromeria biflora* (east tropical and South Africa and Cameroons), *Plantago palmata* (Kilimanjaro to Cameroons), *Rumex Steudelii* (east tropical Africa and Cameroons). Twice as many are restricted to Eastern Africa including the Central Lake district: such are *Polygala persicariæfolia, Sida rhombifolia, Geranium aculeolatum, Coreopsis abyssinica, Lactuca abyssinica, Lysimachia africana, Moschosma multiflorum, Plectranthus Schimperi, Rumex abyssinicus*, which have a northward range, generally as far as Abyssinia; and others with a more southern or restricted distribution, such as *Torilis gracilis* (Usambara, Milanji), *Cynoglossum geometricum* (British East Africa and Shire Highlands), *Solanum aculeatum* (Uganda, Shire Highlands and South Africa), *Lissochilus Krebsii* (a South African species found in the highlands of Portuguese East Africa and Milanji), *Disa Stairsii* (Kenia, Kilimanjaro), and the endemic species *Vernonia ruwenzoriensis, Lissochilus ruwenzoriensis* and *Satyrium crassicaule*. At this altitude were also collected the north temperate species *Sanicula europæa* and *Orobanche minor*. The following novelties were found:—*Begonia Wollastoni* allied to *B. Johnstoni* from Kilimanjaro and Kenia, *Pentas pubiflora* var. *longistyla, Pavetta ruwenzoriensis*, also collected by Scott Elliot at 7000–8000 ft. and in Uganda, *Grumilea megistosticta, Vernonia Wollastoni, Conyza scariosa, Senecio Wollastoni, Plectranthus Wollastoni, Peperomia ruwenzoriensis*, closely allied to *P. Stuhlmanni*, another endemic species, and *Polystachya bicarinata*.

Between 7000 and 8000 feet is found the biggest forest of Ruwenzori. A large *Dombeya* with clusters of white flowers is very noticeable, and one of the finest trees, though not very numerous, is a *Podocarpus*. A sweet-scented begonia (probably *Begonia Wollastoni*) is found about the lower trunks, and tree-ferns occur in shady places and on the banks of the streams.

At 8000 feet were collected the widely spread tropical African highland species *Stachys aculeolata* (Cameroons, Clarence Peak Fernando Po, and Abyssinia), *Begonia Meyeri-Johannis*, previously found on Kilimanjaro, and *Habenaria Rendlei*, previously collected by Scott Elliot at 6000–7000 ft. Also *Hibiscus diversifolius* var. *granatensis*, a tropical South American variety which is also recorded from Uganda.

8000–9000 feet. The slope of the mountains becomes much steeper, and the forest thins out into open spaces covered with bracken and occasional big trees, having very much the appearance of the higher slopes of the New Forest. This gives way to a belt of small tree-heath (*Erica arborea*) and *Podocarpus*, and so to the zone of bamboos, which begin on the east side of Ruwenzori

at about 8500 feet and continue up to 10,000 ft., while on the western slopes they begin at 7000 feet.

9000–10,000 feet. The big tree-heaths begin about 9500 feet, their branches are covered with long wisps of grey lichen. A good many terrestrial orchids were found at this level (*Epipactis africana*, *Cynorchis anacamptoides*, *Satyrium crassicaule* and *Polystachya gracilenta*), all endemic species previously collected at similar altitudes by Scott Elliot and Stuhlmann, and two new species of *Polystachya* were found on rocks, while the epiphytic *Angræcum Scotellii*, found previously by Scott Elliot, was again collected. A big bushy *Impatiens*, the endemic species *I. runssorensis* with a coral-red flower, was also found. Ferns, notably polypodiums and a long narrow-leaved hart's-tongue (?), are numerous, and the biggest of the alchemillas, *A. ruwenzoriensis*, forms large silvery beds. A *Helichrysum* (*H. argyrocotyle*, sp. nov.) in the moist places and a small yellow orchid (*Polystachya Doggettii*) on the rocks contribute agreeable touches of colour.

In addition, the following novelties were collected at 9000 ft.:—*Senecio jugicola*, *Coleus latidens*, *Pycnostachys Elliotii*, and a remarkable amaryllidaceous plant which seems to represent a new genus (*Choananthus*) combining in some respects the characters of *Hæmanthus* and *Cyrtanthus*. At 10,000 ft. were found *Thalictrum rhynchocarpum*, a species widely spread on the mountains of tropical and South Africa, a variety of *Cotyledon Umbilicus* known also from the mountains of Abyssinia and Kilimanjaro, several endemic species (*Rubus Doggettii*, *Solanum runsoriense*, *Mimulopsis Elliotii* and *Arisæma ruwenzoricum*), and a new species, *Coleus elivicola*.

10,000–11,000 feet. This is the zone of moss par excellence. It forms round cushions on the trees (most of them *Erica arborea*) and masses two feet deep on the ground and amongst the fallen logs, where the hyraxes make their burrows. Two tree-lobelias (*L. Deckenii* and *L. Stuhlmanni*) appear at this level, also a fine tree-hypericum with a big yellow flower. A blue violet (*Viola abyssinica*) is found in the more open spaces. At 11,000 ft. were found two new species, *Conyza montigena* and *Calamintha parvula*, and the widely spread north temperate *Cerastium vulgare*.

11,000–12,000 feet. Helichrysums (including a new species *H. Wollastoni*), tree-lobelias, tree-heaths and tree-senecios are the most conspicuous plants at this altitude, though the two latter attain their greatest growth above 12,000 feet. A handsome *Rubus* (*R. runssorensis*) with a pink flower and a large but tasteless fruit is fairly abundant, and a small *Sedum* (*S. ruwenzoriense*, sp. nov.) grows on the rocks. The plants found at 12,000 feet include *Alchemilla geranioides*, a species allied to *A. cinerea* from Kilimanjaro, *Alchemilla argyrophylloides*, a new species allied to *A. argyrophylla* from Kilimanjaro, *Senecio sycephyllus* (previously collected by Scott Elliot), the tree-senecio, *S. adnivalis* allied to *S. Johnstoni* from Mt. Kilimanjaro and *S. keniense* from Mt. Kenia; several alpine species which have been found on the mountains of

Abyssinia and Kilimanjaro—*Ranunculus oreophytus*, *Cardamine obliqua* and *Subularia monticola*; *Hypericum keniense* (also on Mt. Kenia) and *Peucedanum Kersteni* (also on Kilimanjaro),

12,000–15,000 feet. The tree-heaths cease about 12,500 ft., but the senecios continue much further, almost to 14,000 ft. A fourth species of *Lobelia* (*L. Wollastoni*, allied to *L. Rhynchopetalum* from the mountains of Abyssinia) appears at about 12,500 ft. and is found growing on the steepest slopes almost up to the snow-line. *L. Deckenii*, which grows only on the level terraces in very moist ground, does not occur above 13,000 feet. Helichrysums, sometimes forming bushes four or five feet high, grow most luxuriantly in this region, one species (*H. Stuhlmanni*, var. *latifolium* var. nov.) being found nearly up to 15,000 ft. A small *Arabis* (*A. alpina*) was found at 14,000 ft., and a rush (*Luzula Johnstoni*), a grass (*Poa glacialis*) and mosses were found growing up to the level of permanent snow.

To this zone belong the following plants :—*Galium serrato-hamatum*, sp. nov. (at 12,500 ft.), *Helichrysum Stuhlmanni* (at 13,000 ft.), *Senecio gymnoides*, sp. nov. (at 12,500 ft.), *Rubus runssorensis* and *Sedum ruwenzoriense*, sp. nov. (at 12,500 ft.), the latter closely allied to *S. Volkensii* from Kilimanjaro. At 12,500 ft. were found two Cyperaceæ, *Carpha Emini* (previously collected by Stuhlmann at 10,000 ft.) and *Carex runssoroensis*. At 14,000 ft. was found an interesting new alchemilla (*A. subnivalis*).

Appended are some notes by Mr. Woosnam on the arborescent senecios and lobelias, both of which are long-lived.

"With regard to the length of life of the lobelias and senecios on Ruwenzori, it appeared to me that both must live to a great age. The senecios undoubtedly attain the greatest age, which I do not think would be too much to estimate at anything from 50 to 100 years or even more. The senecio appears at first as a small plant not unlike a cabbage, gradually the stem lengthens and gives out branches with the tuft of bright green leaves at the end ; as the plant grows the old leaves shrivel and droop, hanging down the stem one upon another till the upper parts of the branches near the green tuft are transformed into great swollen masses of dead leaves tightly packed together. This accumulation of old leaves is the greatest proof of age, and also there are very few dead trees that have fallen lying among the others, and these had all been there for many years. How often the senecios flower I cannot say, but I do not think the act of flowering means death as it does with the lobelias, and I should say that the senecio flowers every few years.

"The lobelias also live to a great age, but not so long as the senecios. In the case of the lobelias the period which occupies so long a time is before they come into blossom, which might be 15 or 20 years, and the proof of this is also the accumulation of leaves below the flower-spike, or in the case of *L. Stuhlmanni* the marks where the old leaves have fallen off. Once a lobelia has

reached the stage of producing a flower-spike and bursting into blossom, it has (in comparison to the length of time taken before that stage) reached the end of its life; it may perhaps take 12 months for the spike to finish blossoming, then the whole plant withers and dries up and stands probably for several years longer before it falls and is swallowed up by the moss. In *L. Stuhlmanni* the leaves do not die and remain on the plant, but all fall off, leaving the stem bare except for the green leaves. In *L. Deckenii* none of the leaves ever fall off, and the stem is entirely concealed from sight from the ground up to the spike, which is nearly three times as large in circumference as in any of the other lobelias, but I think the life of *Deckenii* is shorter than the others. In *L. Wollastoni* some leaves fall off and some remain hanging down, so that it usually has a portion of exposed stem, 3 or 4 feet long, below the leaves. In *L. Giberroa* the leaves fall off as in *Stuhlmanni*. There is another point about *Deckenii*. When we visited Ruwenzori I saw only one *Deckenii* in blossom, there were hundreds of tall dead ones and as many young ones a foot or so high; this looks as if this species had periods of flowering, all the plants coming into flower at the same time every few years.

"*L. Deckenii* is confined to the flat swampy bottoms of the higher valleys and does not grow on the sloping hillsides which are covered with *L. Wollastoni*; this latter may be seen by hundreds in all stages of development from seedlings to full bloom."

MONOCOTYLEDONS.

By A. B. Rendle.

ORCHIDEÆ.

Eulophia subulata, *Rendle, in Journ. Bot.* xliii. (1895) 167.

Semliki Valley. July. "Flowers yellow."

Previously collected by Scott Elliot at the Katonga River, Uganda.

Lissochilus Livingstonianus, *Reichb. f. Otia Bot. Hamb.* ii. 114.

S.E. 3500 ft. June. "Flowers yellow."

Distrib. British East Africa and British Central Africa.

The flowers of *L. Livingstonianus* are described as purple or white veined with purple-white. Dr. Wollaston describes the flowers of the plant found on Ruwenzori as yellow. I can find no other differences.

L. Krebsii, *Reichb. f. in Linnæa*, xx. (1847) 685.

E. 7000 ft. February. "Flowers yellow and brown."

Distrib. British Central Africa; South Africa.

The bracts are longer and more pointed than usual in this species.

LISSOCHILUS RUWENZORIENSIS, *Rendle, in Journ. Bot.* xliii. (1895) 170.

E. 7000 ft. February. "Flowers yellow and brown."

Previously collected by Scott Elliot on Ruwenzori at 6000 to 7000 ft. on the Eastern side, and at Kivata.

POLYSTACHYA DOGGETTII, *Rendle et Rolfe*, sp. nov.

Planta sicca nigrescens, *Polystachyæ Rendlei*, Rolfe, affinis sed ut apparet caule breviore uni- vel bi-folio; foliis lineari-oblongis, obtusis; bracteis brevibus, late ovatis, truncatis, breviter acuminatis; floribus luteis, galeatis; sepalo dorsali triangulari-ovato, concavo, sepalis lateralibus late triangularibus, subobtusis, sepalum dorsale vix excedentibus, mento valde obtuso; petalis e basi angusto spathulato-lanceolatis, obtusis, sepalis paullo brevioribus; labello breviter unguiculato, trilobato, lobis lateralibus late rotundatis, lobo medio minore subrotundo, disco glabro, verruculoso; columna brevissima.

Hab. Ruwenzori E. 10,000 ft. On rocks. February. "Flowers yellow." Also 8500–11,000 ft. W. G. Doggett. (Herb. Kew.) "Flowers-primrose-yellow."

Folia 5-nervia, 8·5–12 cm. long., 1·1–1·7 cm. lat. Pedunculus basi vaginatus, compressus, cum racemo simplice 5–7-floro, vel interdum pauciter ramoso, 10–15 cm. long. Bracteæ 4–3 mm. long. Flores subsessiles. Sepalum dorsale 9–10 mm. long., 5–6 mm. lat.; sepala lateralia 1 cm. long., mentum 8–9 mm. long. Petala 7–8 mm. long. Labellum 9 mm. long., 5 mm. lat.

Near *P. Rendlei*, Rolfe, from Nyasaland (Mt. Milanji and Zomba), but apparently a lower-growing plant, and distinguished by its short truncate bracts, larger flowers, and lip with glabrous uncrested disc.

P. WOOSNAMI, sp. nov.

Herba parva foliis tribus oblongo-linearibus vel linearibus; scapo compresso, hispidulo; racemo simplici, brevi, denso; bracteis setaceo-acuminatis; floribus parvis luteis cucullatis; sepalis apice acuminato crassatis, sep. dorsali concavo late ovato, sep. lateralibus oblique triangularibus 4-nerviis, mento conico; petalis minimis lineari-oblongis; labello e basi longo cuneato trilobato, lobis lateralibus late rotundatis, lobo medio duplo minore suborbiculare papilloso; columna brevi, crassa.

Hab. Ruwenzori E. 9000 ft. February. On rocks.

Planta, pseudobulbo exciso, 15 cm. long. Folia ad 13·5 cm. long. et vix 1 cm. lat. Scapus cum bracteis tribus pæne ad racemum vaginatus cum racemo (vix 2 cm. excedente) 8·5 cm. long. Bracteæ inferiores vix 1 cm. long., supra breviores, ad racemi apicem comosæ. Flores subsessiles, anguste cucullatæ, vix 1 cm. long. Sepalum dorsale 4 mm. long., 2 mm. lat.; sepala lateralia 9 mm. long., mentum vix 4·5 mm. long.

Petala 2 mm. long. vix 1 mm. lat. Labellum 7·5 mm. long. vix 4 mm. lat., cum venis tribus longitudinalibus, antice in venis et venulis papillosum. Columna 2 mm. long.

Near *Polystachya Adansoniæ*, Reichb. fil., from Angola, in habit, but has longer narrower flowers arranged in a shorter more crowded raceme with longer floral bracts, and differs also in the details of structure of petals and lip.

POLYSTACHYA BICARINATA, sp. nov.

Planta habitu *P. cultratæ*, floribus autem duplo majoribus, sepalo dorsali ovato-oblongo, acuto, 3-nervio, sepalis lateralibus falcate triangulari-ovatis acutis dorso late carinatis, incomplete 5-nerviis, mentum obtusum; petalis quam sepalis brevioribus, oblongo-spathulatis, abrupte subacutis, 3-nerviis; labello e basi lato trilobato, lobis lateralibus rotundatis, lobo medio his subæquali, breviter apiculato, disco cum crista linguiformi; columna crassa, brevi.

Folium late oblongum, ad basin angustatum, plurinervium, 16 cm. long., pæne 4 cm. lat. Scapus cum panicula densiuscula folio brevior. Bracteæ amplæ, 5 mm. long. Flores albi, circa 1·5 cm. long. Sepala 1 cm. long., dorsale 5 mm. lat., lateralia 7 mm. lat. Petala vix 7 mm. long., vix 3 mm. lat. Labellum 8·5 mm. long., 7 mm. lat., lobus medius 4 mm. long. et lat. Columna 2 mm. long.

Hab. Ruwenzori E. 7000 ft. January. Growing on tree-trunks.

Closely allied to *P. cultrata*, Lindl., but distinguished by its much larger bracts and flowers and characters of the lip.

P. GRACILENTA, *Kränzl. in Engl. Jahrb.* xix. (1894) 251.

W. 10,000 ft. August. Flowers white, growing in long grass.

Previously collected by Stuhlmann at 8200 ft., and by Scott Elliot (fruiting specimen) at Butagu, 8000 ft.

ANGRÆCUM SCOTTELLII, *Rendle, in Journ. Bot.* xliii. (1895) 249.

E. 9000 ft. "Parasitic in big trees." January.

Previously collected by Scott Elliot on Ruwenzori at 7000 (Butagu) and 8000 ft.

EPIPACTIS AFRICANA, *Rendle, in Journ. Bot.* xliii. (1895) 252.

E. 9000 ft. In fruit; February.—W. 10,000 ft. In flower; August. "Flowers greenish-yellow."

Previously collected by Scott Elliot on Ruwenzori at Butagu, 8000 to 10,000 ft.

HABENARIA RENDLEI, *Rolfe, in Dyer, Fl. Trop. Afr.* vii. 213.

E. 8000 ft. February. "Flowers green."

Previously collected by Scott Elliot on Ruwenzori at 6000 to 7000 ft.

CYNORCHIS ANACAMPTOIDES, *Kränzl. in Engl. Pflanzenw. Ost-Afr.* C. 151.
W. 10,000 ft. August. "Flowers blue."
Distrib. Ruwenzori, previously collected by Stuhlmann 8200 ft., and Scott Elliot 9000 to 10,000 ft. (Butagu and Kivata).

SATYRIUM CRASSICAULE, *Rendle, in Journ. Bot.* xliii. (1895) 295.
W. 7000 ft. August. "Flowers lilac."—E. 10,000 ft. February. "Flowers pink."
Distrib. Ruwenzori, previously collected by Scott Elliot at Wimi, 6000 to 7000 ft., and Butagu, 10,000 ft.

DISA STAIRSII, *Kränzl. in Gard. Chron.* ser. 3, xii. (1892) 728.
W. 7000 ft. August. "Flowers purple."
Distrib. Mt. Kenia, 10,400 ft. (Gregory); Ruwenzori, Butagu Valley, 10,000 to 12,000 ft., and Yeria Valley, 10,000 ft. (Scott Elliot, also Stairs); Kilimanjaro, 8000 to 10,000 ft. (Volkens).

ZINGIBERACEÆ.

AMOMUM ANGUSTIFOLIUM, *Sonnerat, Voy. Indes*, iii. 276.
E. 7000 ft. January. "About 5 feet high."
Distrib. East and West tropical Africa, also Madagascar and Mauritius.
Collected by Scott Elliot in the Semliki Valley, and on the west side at the foot of Ruwenzori.

AMARYLLIDACEÆ.

CRINUM SCABRUM, *Herb. in Bot. Mag.* t. 2180.
E. 5000 ft. March. "Flowers pink and white."
Distrib. Abyssinia to the Nile Valley.

C. GIGANTEUM, *Andr. Bot. Rep.* t. 169.
W. 6000 ft. July. "Flowers white and pink."
Distrib. Nyasaland, South, Central and West tropical Africa.

HÆMANTHUS MULTIFLORUS, *Martyn, Icon. cum descript.*
E. 7000 ft. January. "Flowers pink."
Distrib. Widely spread in tropical Africa.
Collected by Scott Elliot on Ruwenzori in forest at 8000 ft.

CHOANANTHUS, gen. nov. (Greek χοάνη, a funnel.)

Perianthium anguste infundibuliforme, tubo longo angusto, fauce nuda, lobis multo brevioribus latis erecto-patentibus. Stamina ad perianthii faucem inserta, filamentis latis anguste triangularibus apice acuminatis, antheris

oblongis medio dorso affixis, versatilibus. Ovarium triloculare; stylus filiformis exsertus; stigma parvum, indistincte trilobulatum; ovulum in loculis solitarium, pendulum. Bacca subglobosa. Habitu *Hæmanthi* cum floribus *Cyrtanthi*. Species 2.

The foliage resembles that characteristic of other tropical African species of *Hæmanthus*, and the few-celled ovary and berried fruit also point to the same genus, but the shape of the flower is different from that of any known species. The flowers resemble those of a *Cyrtanthus*, especially the South-African *C. carneus*, having the long narrow tube and short broad lobes of that species. I therefore venture to separate as a new genus these two alpine species, namely, the new one collected by Dr. Wollaston and a very closely allied species recently collected by Mr. Dawe at 8000 to 9000 ft. on the same mountain, and described by Mr. Wright under the name *Hæmanthus cyrtanthiflorus* (in Journ. Linn. Soc., Bot. xxxvii. (1906) 529). In CH. CYRTANTHIFLORUS an ovoid bulb grows from a rhizome 3 cm. thick, while in *Ch. Wollastoni* Dr. Wollaston states that the leaves and scape spring direct from the stout rhizome. A similar absence of a bulb occurs in the Uganda species *Hæmanthus Radcliffei*, where scape and leaves spring from the apex of a short stout rhizome, and the association of bulb and rhizome occurs in other tropical African species of that genus, as in *H. multiflorus*.

CH. WOLLASTONI, sp. nov.

Herba rhizomata, foliis magnis ovalibus multinerviis, basi in vaginas angustas semet involventes contractis; scapo multifloro (specimine 25), floribus puniceis, quasi umbellatis, demum recurvatis; bracteis spathaceis membranaceis angustis brevibus; pedicello gracile quam flore breviore; tubo perianthii sursum gradatim ampliato, lobis ellipticis vel elliptico-oblongis, apice cucullato puberulis; staminibus lobos vix æquantibus; ovario ovoideo.

Hab. Ruwenzori E. 9000 ft. In flower February.

Folii lamina 3 dm. long., 1 dm. lat. Scapus 3·3 dm. long., ·5 cm. lat. Pedicellus ad 2·5 cm. long.; flos 6 cm. long., tuba c. 4 cm. long, fauce c. 1·2 cm. lat., lobis vix 2 cm. long., 8–10 mm. lat., interioribus paullo brevioribus et obtusioribus. Ovarium c. 5 mm. long.

Closely allied to *Ch. cyrtanthiflorus*, but the flowers have a wider tube with a broader throat and broader limbs. The leaf is also broader and the inflorescence bears twice as many flowers.

LILIACEÆ.

ALOE WOLLASTONI, sp. nov.

Herba caulescens (?), foliis crassis, parvis, ensiformibus, haud maculatis, marginibus corneis cum dentibus validis uncinatis frequentibus armatis; scapo pauciter ramoso nudo, racemis densiusculis paucifloris; bracteis

scariosis, ovatis, acuminato-aristatis, reflexis quam pedicellis brevioribus ; perianthio roseo cylindraceo, super ovarium constricto, segmentis liberis quam tubo duplo brevioribus, externis trinerviis, internis plurinerviis ; filamentis vix exsertis ; antheris et apice styli protrusis ; capsulo immaturo oblongo.

Hab. Ruwenzori S.E. 3500 ft. May. Flowers pink.

Folia 14–15 cm. long. e basi 2·5–3 cm. lat. sensim angustata, spinis 3 mm. long., 5–7 mm. inter se distantibus. Racemi 4–6 cm. long. ; bracteæ trinerviæ, 1 cm. long. vel breviores. Flores circa 3 cm. long., segmenta 10–12 cm. long.

Apparently near *Aloe amanensis*, A. Berg., from East Usambara, which I know only from the description, but which has larger spotted leaves with smaller teeth. The bracts and flowers resemble those of *A. lateritia*, Engl., from Mt. Kilimanjaro, but the leaves are much smaller than in that species and the marginal teeth are less continuous.

CHLOROPHYTUM RUWENZORIENSE, sp. nov.

Herba minor, foliis radicalibus circa 5 rigidulis, lamina e petiolo tenue anguste lanceolata, acuminata, sicca submembranacea, glabra, cum nervo mediano et venis parallelis utrinque (circa 9) frequentissime et regulariter lineatis ; scapo cum racemo brevi densiusculo quam foliis breviore ; bracteis scariosis longe acuminatis ; floribus inter majores in axillis geminis, pedicellis medio articulatis quam bracteis duplo brevioribus ; perianthio albo rotato-expanso, lobis anguste lanceolatis, trinerviis ; staminibus erectis perianthio brevioribus ; antheris dehiscentibus flexuosis.

Hab. Ruwenzori S.E. 3500 ft. June. Flowers white.

Folia ad 23 cm. long., lamina circa 15 cm. long. ad 13 mm. lat. inclusa ; scapus cum racemo 5–8 cm. long., 12–18 cm. lat. Bracteæ, in parte racemi inferiore 1·5 interdum 2·5 cm. long., e basi triangulari-ovato, acuminatæ vel aristuliferæ. Pedicelli c. 6 mm. longi. Petala 13 mm. long., 3–3·5 mm. lat. Stamina, cum antheris viridescentibus 3 mm. longis, vix 9 mm. long. Stylus stamina excedens.

Near my *C. fusiforme*, from Uyui, East Africa, which it resembles in habit, but has more rigidulous, more distinctly petioled glabrous leaves, and larger flowers.

C. MACROPHYLLUM, *Aschers. in Schweinf. Beitr. Fl. Aeth.* 294, *et ex Baker, in Trans. Linn. Soc., Bot.* ser. 2, i. (1878) 259.

E. 7000 ft. January. "Flowers white."

Distrib. Widely spread in tropical Africa.

ORNITHOGALUM ECKLONI, *Schlecht. in Linnæa*, xxv. 1177.

Semliki Valley. 3000 ft. June. "Flowers pale green."

Distrib. East tropical Africa, Angola, South Africa.

GLORIOSA VIRESCENS, *Lindl.*, var. SPLENDENS, var. nov.

Planta egregia foliis late lanceolatis vel ovatis apice acuminato cirrhosis, floribus flavo-rubris quam in typo majoribus cum petalis latioribus.

Folia ad 15 cm. vel longiora et 5 cm. lat. Flores sicci cum petalis patentibus sæpe 16 cm. diam., petala 6–8 cm. long., 2·5–3·5 cm. lat.

Hab. Ruwenzori E. 6000 to 7000 ft. January. "Flowers yellow and red."

A very fine plant, distinguished from other forms of the species by its larger flowers with broad oval petals tapering to the base.

COMMELINACEÆ.

ANEILEMA BENINIENSE, *Kunth, Enum.* iv. 72.

E. 7000 ft. January.

Also collected by Scott Elliot in the Butagu Valley.

Distrib. Widely distributed in tropical Africa.

JUNCACEÆ.

LUZULA JOHNSTONI, *Buchenau, in Engl. Bot. Jahrb.* xii. (1890) 79.

E. 13,000 ft. February.

Distrib. Mt. Kilimanjaro, 8000–9000 ft. (Johnston, Volkens).

AROIDEÆ.

ARISÆMA RUWENZORICUM, *N. E. Br. in Dyer, Fl. Trop. Afr.* viii. 143.

E. 10,000 ft. April.

Originally collected by Scott Elliot on Ruwenzori at 7000 to 8000 ft. in the forest at Kivata.

The specimen is of interest in view of an uncertainty as to the nature of the leaf. Mr. Elliot's specimens, to which our knowledge of the species has hitherto been restricted, comprise an inflorescence with some unattached leaves, one of them with a pedate arrangement of the leaflets, the other with radiating leaflets. Mr. Brown says (*l. c.*) : "Both leaves may possibly belong to the inflorescence, but more complete material is needed to decide, as I have never seen a species of *Arisæma* having both radiating and pedately arranged leaflets ; such a difference has hitherto been considered of sectional value." In Dr. Wollaston's specimen the leaf has pedately arranged leaflets and is attached to the inflorescence.

CULCASIA SCANDENS, *Beauv. Fl. Owar.* i. 4, t. 3.

E. 7000 ft. January.

Distrib. Widely distributed in tropical Africa.

CYPERACEÆ.

CARPHA EMINI, *C. B. Clarke, in Dyer, Fl. Trop. Afr.* viii. 483.
(*Oreograstis Emini*, K. Schum. in Engl. Pflanzenw. Ost-Afr. C. 127.)
E. 12,500 ft. February.
Previously collected by Stuhlmann at 10,000 ft.

CAREX RUNSSOROENSIS, *K. Schum. in Engl. Pflanzenw. Ost-Afr.* C. 129.
E. 12,500 ft. February.
Previously collected by Stuhlmann and Doggett at similar elevations.

GRAMINEÆ.

PANICUM PLICATUM, *Lam. Encycl.* iv. 736.
S.E. 3500 ft.—E. 7000 ft.
Distrib. Widely spread in the tropics.

CYMBOPOGON CYMBARIUS, nom. nov.
(*Andropogon cymbarius*, Linn. Mant. ii. 303.)
E. 7000 ft. January.
Also collected by Scott Elliot at 5300 ft. and 7000 ft.
Distrib. East and West tropical Africa, Mascarene Islands, with a variety in South Africa.

POA GLACIALIS, *Stapf, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 532.
E. 14,000 ft.
Previously collected by Doggett at similar altitudes.

DICOTYLEDONS.

POLYPETALÆ.

By EDMUND G. BAKER.

RANUNCULACEÆ.

CLEMATIS ORIENTALIS, *Linn.*, subsp. WIGHTIANA, *O. Kuntze, in Verh. Bot. Ver. Brand.* xxvi. (1885) 125.
Beni, Semliki. 3000 ft. July.
Distrib. of subsp. Nile Land, Mt. Kilimanjaro, Lower Guinea ; also India.

THALICTRUM RHYNCHOCARPUM, *Dill. et Rich. in Ann. Sc. Nat.* sér. 2, xiv. (1840) 262.
10,000 ft. February.
Also collected by Scott Elliot.
Distrib. Widely spread on the mountains of tropical Africa. Also in Orange River Colony and on the Katberg, &c.

Ranunculus oreophytus, *Delile, in Ann. Sc. Nat.* sér. 2, xx. (1843) 89.
E. 12,000 feet. February.
Distrib. Nile Land, Mt. Kilimanjaro.

R. membranaceus, *Fres. in Mus. Senckenb.* ii. 270. (*R. pinnatus*, Oliver, Fl. Trop. Afr. i. 9.)
E. 7000 ft. February.
Distrib. Nile Land, Mozambique District, Lower Guinea.

CRUCIFERÆ.

Cardamine obliqua, *Hochst. ex A. Rich. Tent. Fl. Abyss.* i. 19.
E. 12,000 ft. February.
Distrib. Nile Land, Mt. Kilimanjaro.

Arabis alpina, *Linn. Sp. Pl.* 664.
E. 13,000 ft. and 14,500 ft. February.
Distrib. Nile Land, Mt. Kilimanjaro.
A widely spread species in Europe, N. Asia, N. America, &c.
Prof. Oliver considers *A. albida*, Stev., to be synonymous with *A. alpina*.

Subularia monticola, *A. Br. in Schweinf. Fl. Æth.* 76.
E. 12,000 ft. February. And on shore of small crater lake, 10,000 ft., March.
Distrib. Nile Land, Mt. Kilimanjaro.

VIOLARIEÆ.

Viola abyssinica, *Steud. ex Oliver, Fl. Trop. Afr.* i. 105.
E. 11,000 ft. February.
Also collected by Scott Elliot (No. 7523) in bamboo forest.
Distrib. Widely spread on the mountains of tropical Africa.

POLYGALACEÆ.

Polygala persicariæfolia, *DC. Prod.* i. 326.
E. 7000 ft. February.
Distrib. Nile Land, Mozambique District, Lower Guinea. Also in India, &c.

CARYOPHYLLACEÆ.

Cerastium vulgare, *Linn. Sp. Pl.* 627.
E. 11,000 ft. April.
Distrib. Mountains of Abyssinia, Mt. Kilimanjaro, Cameroons, &c. Widely spread in north temperate regions.

HYPERICACEÆ.

HYPERICUM KENIENSE, *Schweinf. ex Engl. Hochgebirgsfl.* 308.

E. 12,000 ft. February.

This identification is doubtful, as I have seen no good description of this species.

Distrib. Mt. Kenia.

MALVACEÆ.

SIDA RHOMBIFOLIA, *Linn.*, var. (*Sida riparia*, Hochst.)

E. 7000 ft. February.

Distrib. of variety. Mountains of Abyssinia.

S. SPINOSA, *Linn. Sp. Pl.* 683.

S.E. 3500 ft. May.

Distrib. A widely spread tropical weed.

PAVONIA MACROPHYLLA, *E. Meyer, ex Harv. & Sond. Fl. Cap.* i. 169.

S.E. 3500 ft. June.

Also collected by Scott Elliot at Kedung Ndogo (No. 6615).

Distrib. Tropical and South Africa.

P. SCHIMPERIANA, *Hochst. ex Rich. Tent. Fl. Abyss.* i. 52, forma.

E. 7000 ft. January.

"Shrub 5–10 ft. high; flowers white." A form with rather small, not very deeply-lobed, pubescent leaves, less hairy than in *P. tomentosa*, Hochst.

Distrib. of type. Nile Land, Mozambique District.

KOSTELETZKYA ADOENSIS, *Masters, in Oliver, Fl. Trop. Afr.* i. 194.

E. 7000 ft. January.

Also collected by Scott Elliot (Nos. 7748 & 7754).

"Herbaceous; flowers blue."

Distrib. Nile Land, Mozambique District.

HIBISCUS CANNABINUS, *Linn. Syst.* ed. x. 1149.

S.E. 3000 ft. June.

"Herbaceous, 6–10 ft.; flowers yellow."

Distrib. Widely spread in tropical Africa. Also India and other parts of Asia and subtropical Australia.

H. DIVERSIFOLIUS, *Jacq.*, var. GRANATENSIS, *Triana & Planch. Prod. Fl. Novo-Granatensis*, 165.

E. 8000 ft. January.

Distrib. of variety. Tropical S. America; also recorded from Uganda.

HIBISCUS MICRANTHUS, *Linn. f. Suppl.* 308, 310.
S.E. 3500 ft. May.
"Herbaceous; flowers blue."
Distrib. Widely spread in tropical Africa. Also occurs in India, Ceylon, Arabia.

H. CRASSINERVIS, *Hochst. ex Rich. Tent. Fl. Abyss.* i. 61.
S.E. 3500 ft. June.
"Herbaceous; flowers red."
Distrib. Nile Land.

H. ÆTHIOPICUS, *Linn. Mant.* ii. 258.
S.E. 3500 ft. June.
Collected by Scott Elliot on Maungu (No. 6740), also in Karagwe (No. 8140).
Distrib. East tropical and South Africa.

TILIACEÆ.

TRIUMFETTA RUWENZORIENSIS, *Sprague, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 503.
6000–7000 ft. January.
"Herbaceous; flowers yellow."
The type was collected by Mr. Dawe at an altitude of 6000 ft.
Distrib. Mt. Ruwenzori.

GREWIA SIMILIS, *K. Schum. in Engl. Bot. Jahrb.* xv. (1893), 118, *ex descript.*
S.E. 4000 ft. June.
"Bush 15–20 ft.; flowers pink."
Distrib. Nile Land, Mozambique District.

CORCHORUS TRILOCULARIS, *Linn. Mant.* 77.
S.E. 3500 ft. May.
"Herbaceous; flowers yellow."
Distrib. Tropical Africa.

GERANIACEÆ.

GERANIUM ACULEOLATUM, *Oliver, Fl. Trop. Afr.* i. 291.
E. 7000 ft. January.
Collected also by Scott Elliot (Nos. 7577–7651)
"Herbaceous; flowers pink."
Distrib. East tropical Africa.

OXALIS CORNICULATA, *Linn. Sp. Pl.* 435.
E. 7000 ft. March.
Distrib. A weed of cultivation and waste ground in nearly all warm countries.

IMPATIENS RUNSSORENSIS, *Warb. in Engl. Pflanzenw. Ost-Afr.* C. 254, *ex descript.*
E. 10,000 ft. February.
"Herbaceous, 4–12 ft.; flowers red."
Distrib. Mt. Ruwenzori.

I. EMINII, *Warb. l. c., ex descript.*
E. 7000 ft. January.
Distrib. of type. Mt. Ruwenzori. Var. *lenduensis*, Warb., from Lendu.
Another species described from Mt. Ruwenzori is *I. Stairsii*, Warb.

MELIACEÆ.

MELIA AZEDARACH, *Linn. Sp. Pl.* 384.
S.E. 3500 ft. May.
Distrib. Widely distributed.

TURRÆA NILOTICA, *Kotschy & Peyr. Pl. Tinn.* 12, t. 6.
S.E. 3500 ft. May.
The plant collected by Mr. Dawe in N.W. Ankole agrees with the above. *T. robusta*, Gürke, from Usambara, is very closely allied.
Distrib. Nile Land.

CELASTRACEÆ.

GYMNOSPORIA GRACILIPES, *Loes. in Engl. Pflanzenw. Ost-Afr.* C. 246. (*Celastrus gracilipes*, Welw. ex Oliver, Fl. Trop. Afr. i. 361.)
E. 7000 ft. February.
"Tree, 20–30 ft.; flower white; fruit red.
Distrib. Upper and Lower Guinea.

G. LEPIDOTA, *Loes. in Engl. Bot. Jahrb.* xvii. (1893) 549, *ex descript.*
E. 10,000 ft. March.
Distrib. Forests of Ruwenzori. Mt. Kilimanjaro.
I have to thank Mr. Sprague for this identification.

RHAMNACEÆ.

HELINUS MYSTACINUS, *E. Meyer, ex Steud. Nom.* ed. II. i. 742.
S.E. 3500 ft. June.
Distrib. Nile Land, Mt. Kilimanjaro.

AMPELIDEÆ.

CASSUS UKEREWENSIS, *Gilg, in Engl. Pflanzenw. Ost-Afr.* C. 260, t. 27 H–M.
E. 7000 ft. January.
Distrib. Central African Lake-Region.

LEGUMINOSÆ.

CROTALARIA CLEOMIFOLIA, *Welw. ex Baker, in Oliver, Fl. Trop. Afr.* ii. 43.
E. 7000 ft. January.
Distrib. Lower Guinea, Nyasaland.

ADENOCARPUS MANNII, *Hook. fil. in Journ. Linn. Soc., Bot.* vi. (1864) 8.
E. 9000 ft. February.
Distrib. Mt Kilimanjaro, Cameroons, Clarence Peak, Mt. Milanji and Ruchigga.

PAROCHETUS COMMUNIS, *Hamilt. in D. Don, Prod. Fl. Nep.* 240.
E. 6000 ft. February.
Distrib. Mt. Kilimanjaro, Mt. Kenia, Manganya Hills. Also in tropical Asia.

INDIGOFERA LONGEBARBATA, *Engl. Hochgebirgsflora*, 257.
E. 6000 ft. January.
Also collected by Scott Elliot (No. 7767 at 6000–7000 ft.).
Distrib. Abyssinia.

TEPHROSIA PANICULATA, *Welw. ex Baker, in Oliver, Fl. Trop. Afr.* ii. 122.
E. 5000 ft. April.
A form with smaller leaflets than type.
Distrib. of type. Lower Guinea, Uganda.
There is another species of *Tephrosia* in the collection gathered at an elevation of 3500 ft. It is closely allied to *T. bracteolata*, but the flowers are only in bud.

SMITHIA (Kotschya) RUWENZORIENSIS, sp. nov.
Frutex erectus, ramulis viscido-setulosis; stipulis lanceolatis; foliis breviter petiolatis, foliolis circ. 20–30 lineari-oblongis sæpissime alternis, costa submarginali, apice mucronatis, margine antico recto vel subrecto ciliato, petiolo communi setuloso; racemis axillaribus quam foliis sæpissime longioribus apicem versus densifloris; bracteolis ad apicem pedicelli 2 oblongo-lanceolatis vel anguste lanceolatis, margine ciliatis, acutis levissime falcatis; calyce setoso-fimbriato, labio superiore apice bilobato, labio inferiore ultra medium 3-lobato, lobis lateralibus oblongis vel

oblongo-lanceolatis acutis, infimo lanceolato illis angustiore apice acuto; corolla calyce longiore, vexillo obovato unguiculato carinam et alas paullulo excedente, alis inæqualiter oblongis, apice rotundatis, basi unguiculatis, carina naviculariformi, basi unguiculata, apice rotundata; ovario stipitato, articulis sæpissime 2, stipite glabro; stylo gracillimo glabro.

Species *S. æschynomenoidi*, Welw., et *S. sphærocephalæ*, Baker, valde affinis. Ab illa differt floribus majoribus, calycis labio superiore longiore et angustiore, ab hac bracteolis longioribus et leviter falcatis.

Hab. Ruwenzori.

Folia 4·0–5·0 cm. long. Foliola 8–10 mm. long., ±2 mm. lat. Bracteolæ ad apicem pedicelli ±5 mm. longæ. Vexilli lamina 8–9 mm. long., 7–8 mm. lat., ungue ±2 mm. long. Alæ cum unguibus ±1·1 cm. long. Carina cum ungue ±1·1 cm. long. Calycis lab. superius ±8 mm. long.

Noticeable on account of the rather dense racemes generally slightly longer than the leaves, the distinctly stipitate, glabrous, generally biarticulate ovary, slender style, and the lanceolate slightly falcate bracteoles.

DESMODIUM SCALPE, *DC. Prod.* ii. 334.

6000 ft. January.

Distrib. Nile Land, Upper Guinea, Mozambique District; Lower Guinea. Also in Natal, East India, &c.

D. LASIOCARPUM, *DC. Prod.* ii. 328.

Semliki Valley. 3000 ft. July.

"Herbaceous; flowers red."

Distrib. Widely distributed in tropical Africa.

A common Indian and Malayan species.

VIGNA LUTEOLA, *Benth. in Mart. Fl. Bras.* xv. i. 194, t. 50. fig. 2.

E. 6000 ft.

Distrib. Widely distributed in tropical Africa. Also a plant of the Cape, tropical Asia, America.

PSOPHOCARPUS PALUSTRIS, *Desv. in Ann. Sc. Nat.* sér. 1, ix. (1826) 420.

E. 6000 ft. January.

Also collected by Scott Elliot (No. 7748).

Distrib. Widely distributed throughout the Tropics.

BAPHIA (Delaria) WOLLASTONI, sp. nov.

Frutex ramulis cortice griseo-glabris vel glabriusculis, foliis breviter petiolatis oblongo-lanceolatis vel oblongis vel lanceolatis apice longe

acuminatis apice ipso obtusis basi cuneatis vel rotundatis subcoriaceis superne glabris, nervo medio subtus pilosulo, nervis lateralibus tenuibus subtus sub lente tenuiter reticulatis; pedicellis solitariis axillaribus tenuibus vel in racemum brevissimum dispositis; bracteolis reniformi-semiorbicularibus brevissimis; calyce spathaceo subcoriaceo glabro præter apicem puberulum quam vexillo breviori; petalis pallide flavis secus cl. detectorem, vexillo late subovato-orbiculari subsessili, alis inæquilateraliter oblongis unguiculatis, carina apice obtusa basi breviter unguiculata; ovario glabro sæpe 4-ovulato, apice in stylum attenuato.

Species *B. angolensi*, Welw., et *B. bipindensi*, Harms, affinis ab ambabus, differt calyce crassiori subcoriaceo, ab illa pedicellis parum brevioribus et apicem versus pilosulis ab hac ovario glabro.

Hab. Ruwenzori W. 4000 ft. July.

"Shrub. Pale yellow."

Folia 4–8 cm. long., 2·0–2·8 cm. lat.; petioli 2–3 mm. long. Bracteæ ± 1·5 mm. longæ. Calyx 1·5 cm. long. Vexillum ± 2·0 cm. long. Carina ± 2·0 cm. long.

The following short clavis indicates the position of this plant with its nearest allies:—

* Ovarium glabrum vel subglabrum.

† Pedunculi 8–15 mm. Vexillum ± 1 cm. long. fide Harms.

BAPHIA PREUSSII, *Harms.* Cameroons.

†† Pedunculi 2 cm. attingentes. Vexillum in spec. nost. haud bene evolutum.

B. ANGOLENSIS, *Welw.* Angola.

††† Pedunculi 1·3 cm. attingentes sæpissime breviores. Vexillum ± 2 cm. long.

B. WOLLASTONI, sp. nov. Mt. Ruwenzori.

†††† Pedunculi 1·3–2·3 cm. Vexillum 1·3 cm. longum.

B. BAROMBIENSIS, *Taub.* Cameroons.

** Ovarium subsericeo-pubescens.

B. BIPINDENSIS, *Harms.* Cameroons.

ERIOSEMA MONTANUM, *Baker fil. in Journ. Bot.* xliii. (1895) 142.

E. 6000 ft. January.

"Herbaceous; flowers yellow."

Distrib. Nile Land, Mozambique District.

MUCUNA POGGEI, *Taubert, in Engl. Bot. Jahrb.* xxiii. (1896) 194.

E. 4000 ft. July.

"Climbing; flowers pale yellow."

Distrib. Upper and Lower Guinea.

CASSIA DIDYMOBOTRYA, *Fres. in Flora*, xxii. (1839) 53.
E. 7000 ft.
"20–30 ft.; flowers yellow."
Distrib. Nile Land, Lower Guinea, Mozambique District.

C. MIMOSOIDES, *Linn. Sp. Pl.* 379.
S.E. 3500 ft. June.
Distrib. Widely distributed.

C. KIRKII, *Oliver, Fl. Trop. Afr.* ii. 281.
E. 7000 ft. January.
Distrib. Lower Guinea, Mozambique District, Uganda.

ACACIA CATECHU, *Willd. Sp. Pl.* iv. 1079.
S.E. 3500 ft. June.
Distrib. East tropical Africa.
A common Indian species.

ALBIZZIA BROWNEI, *Walp. Rep.* i. 928.
S.E. 3000 ft. June.
"Tree, 70–80 ft.; flowers pink."
Distrib. Upper Guinea, Lower Guinea.

ROSACEÆ.

RUBUS DOGGETTII, *C. H. Wright, in Johnston's Uganda Protectorate*, 325.
E. 10,000 ft. February.
There is a specimen of this plant in Herb. Kew. collected by Mr. Dawe (No. 559).
Distrib. Mt. Ruwenzori.

R. RUNSSORENSIS, *Engl. Pflanzenw. Ost-Afr.* C. 190, *ex descript.*
E. 12,500 ft. February.
Distrib. Mt. Ruwenzori.

ALCHEMILLA RUWENZORIENSIS, *Rolfe, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 514.
E. 11,000 ft. April.
The type was described from specimens collected by Scott Elliot (No. 8109) at an altitude of 12,000 ft., and by Mr. Dawe at 10,000–11,000 ft. (No. 613).
Distrib. Mt. Ruwenzori.

ALCHEMILLA GERANIOIDES, *Rolfe, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 514.
E. 12,000 ft. February.

The type was collected by Mr. Dawe at an altitude of 8,000–11,000 ft. (No. 678). It is allied to *A. cinerea*, Engl., from Mt. Kilimanjaro.

Distrib. Mt. Ruwenzori.

ALCHEMILLA ARGYROPHYLLOIDES, sp. nov.

Suffrutex caule repente, ramis primariis elongatis ramulos breves axillares numerosos emittentibus, praeter stipulas vaginantis sericeo-pilosis; stipulis tenuiter scariosis brunneis margine ciliatis; foliis subsessilibus vel brevissime petiolatis subcoriaceis tripartitis, lobo medio majore oblanceolato-obovato apice tridentato serraturis quam lobis *A. argyrophyllæ*, Oliver, multo brevioribus, lobis lateralibus angustioribus oblanceolatis vel oblongo-oblanceolatis apice haud lobatis omnibus sericeo-pilosis; cymis axillaribus paucifloris floribus pedicellatis; perianthii tubo turbinato, lobis exterioribus lineari-lanceolatis, interioribus multo majoribus ovatis apice subacutis; staminibus 4 filamentis quam perianthii lobis exterioribus brevioribus; carpellis 2–3 glabris oblique ovoideis stipitatis, stylo tenui instructis.

Species *A. argyrophyllæ*, Oliver, affinis, differt foliorum lobo medio antice tridendato haud trilobato, carpellis sæpissime paucioribus.

Hab. Ruwenzori E. 12,000 ft. February.

In flower February. Also collected by Mr. Dawe on Mt. Ruwenzori (No. 615).

Folia 8 mm.–1 cm. long., lobo centrali 2·0 mm.–3·5 mm. lat. Perianthii lobi exteriores vix 1 mm. longi, interiores ± 1·5 mm. longi.

ALCHEMILLA SUBNIVALIS, sp. nov.

Suffrutex diffusus, caule repente ± piloso, ramis primariis in speciminibus mihi obviis haud valde elongatis ramos axillares numerosos emittentibus; stipulis membranaceis pallide brunneis vaginantibus ± pilosis; foliis cuneato-obovatis coriaceis margine antice brevissime trilobatis, lobo medio minore, supra loco costarum et nervorum lateralium insculptis utrinque pilosis basi in petiolum brevem attenuatis; cymis axillaribus paucifloris floribus breviter pedicellatis; calycis tubo glabro statu florifero turbinato; perianthii lobis exterioribus minoribus, interioribus late triangulari-ovatis apice obtusis omnibus margine ciliatis; carpidiis circ. 4 stipitatis glabris, stylo tenuissimo 1½–2-plo longiore instructis.

Species *A. argyrophyllæ*, Oliver, affinis, differt ambitu foliorum valde diverso lobis laminam stricte terminantibus haud alte trilobatis.

Hab. Ruwenzori E. 14,000 ft. February.

Folia cum petiolis 8–10 mm. long., 5–6 mm. lat. Calycis tubus ± 2 mm. longus, lobi interiores ± 1·5 mm. longi. Carpella ± ·75 mm. longa.

This interesting little plant is distinguished from its near allies by the

shape of the leaves, which are cuneate obovate and very shortly petioled and terminate by three short lobes directed forwards. Flowers are difficult to find on our material.

The following clavis indicates the position of these two novelties in relation to the nearest allies. All are pilose or generally sericeo-pilose and have brown, membranous, sheathing stipules.

* Folia cuneato-obovata brevissime trilobata, lobis laminam stricte terminantibus.
ALCHEMILLA SUBNIVALIS, sp. nov. Mt. Ruwenzori.

** Folia tripartita, lobis lateralibus quam lobo centrali angustioribus illius margine integro.

† Lobo centrali late oblanceolato usque ad 3–5 mm. trifido.
A. ARGYROPHYLLA, *Oliver*. Mt. Kilimanjaro.

†† Lobo centrali oblanceolato-obovato usque ad 0·5 mm. dentato.
A. ARGYROPHYLLOIDES, sp. nov. Mt. Ruwenzori.

*** Folia trilobata, lobis omnibus margine anteriore argute serratis.
A. STUHLMANNI, *Engler*. Mt. Ruwenzori.

**** Folia flabellatim 3–5-lobata, margine anteriore serrata.
A. RUWENZORIENSIS, *Rolfe*. Mt. Ruwenzori.

In addition to the plants already mentioned, Mr. G. F. Scott Elliot collected on Mt. Ruwenzori at 7000–10,000 ft. a plant which seems to agree closely with *A. Volkensii*, Engler, the chief difference being the carpels in the plant from Ruwenzori are more numerous.

CRASSULACEÆ.

SEDUM RUWENZORIENSE, sp. nov.

S. caule humifuso repente ad nodos inferiores radicante sparse foliato ramentaceo; foliis ligulati-oblongis vel subspathulatis tenuiter membranaceis, apice obtusis basi cauli peltatim affixis alternis vel suboppositis; inflorescentia corymbosa, ramulis tenuibus curvatis; sepalis lineari-oblongis, basi breviter auriculatis petalis subæquilongis; petalis flavis lineari-oblongis apice obtusis vel subacutis; filamentis filiformibus, antheris breviter ovatis; carpellis ellipticis margine hyalinis sursum in stylos abrupte attenuatis, stylo tenui quam carpella dimidio breviore, stigmate parvo capitellato.

Species *S. Volkensii*, Engler, affinis, differt foliis sæpissime lineari-oblongi floribus paullo majoribus, carpellis sursum in stylos abrupte attenuatis petalis sæpissime apice obtusis.

Hab. Ruwenzori E. 12,500 ft. In flower February.

"Flowers yellow."

Folia 1·0–1·8 cm. long., 3·0–4·0 mm. lat. Sepala $\pm$ 6 mm. longa. Petala $\pm$ 6 mm. longa. Carpella 2·5 mm. long., 1·2 mm. lat. Stylus $\pm$ 1 mm. longus.

Kalanchoe crenata, *Haw.*, var. **collina**, *Engl. Pflanzenwelt Ost-Afr.* C. 189, *ex descript.*

E. 7000 ft. January.

Distrib. of var. Mozambique District.

Cotyledon Umbilicus, *Linn.*, var. **botryoides**, *Engl. Hochgebirgsfl.* 230. (*Umbilicus botryoides*, Hochst. in Schimp. Pl. Abyss. ii. n. 1300.)

E. 10,000 ft. February.

Distrib. of var. Mountains of Abyssinia, Mt. Kilimanjaro.

MELASTOMACEÆ.

Osbeckia densiflora, *Gilg, Monogr. Afr. Melast.* 8, *ex descript.*

E. 6000 ft. January.

This agrees with Dr. Gilg's description, with the exception that the petals in Dr. Wollaston's plant are broader.

Distrib. Mozambique District.

Iristemma incompletum, *R. Br. in Tuckey's Congo, Appendix*, 435.

7000 ft. January.

Distrib. Nile Land, Upper Guinea, Lower Guinea.

BEGONIACEÆ.

Begonia (§ Rostrobegonia) **Wollastoni**, sp. nov.

Herba elata, caule eramoso carnoso terete glabro; foliis mediocriter vel longiuscule petiolatis, petiolo glabro, obliquis, ambitu ovatis apice acuminatis sinu sublateraliter posito, margine distincte inæqualiter serratis, lamina membranacea utrinque sparsissime pilosula et subtus ad nervos venasque pilis albidis sparsissime vestita, nervis ±10 radiantibus omnibus iterum atque iterum furcatis nervo intermedio penninervio, venis laxe reticulatis subtus subprominentibus; stipulis magnis persistentibus ovato-oblongis glabris; inflorescentiis dichotome furcatis; bracteis tenuiter membranaceis, pedunculis tenuibus glabris vel glabrescentibus; floribus secus cl. detectorem puniceis, fl. ♂ sepalis 2 suborbicularibus, petalis 2 quam sepalis multo minoribus obovatis; staminibus numerosissimis basi in columnam brevem connatis superne liberis æqualiter radiantibus antheris rotundatis; fl. ♀ quam fl. ♂ manifeste minoribus, sepalis 2 obovato-orbicularibus et petalis 2 subæqualibus; ovario trialato, stylis a basi liberis horum lobis profunde fissis ramis flabellatim pluripartitis, lobis ultimis apice dense papillosis, fructibus perfecte evolutis haud visis.

Ab *B. Johnstoni*, Oliver, differt foliis laterioribus margine serratis haud crenatis, etc. in fl. ♂ sepalis quam petalis multo majoribus.

Hab. Ruwenzori E. 7000 ft. In flower March.

"Flowers pink."

Folia 10–13 cm. long., 6·5–8·0 cm. lat. Petioli 5·0–10·0 cm. longi, leviter apice crassiusculi, annulo setarum instructi. Stipulæ 1·2–1·5 cm. longæ. Fl. ♂ sepala ± 2·5 cm. longa et lata, petala 1·4 cm. longa. Fl. ♀ sepala ±9 mm. longa.

Evidently allied to *B. Johnstoni*, Oliver, and *B. Engleri*, Gilg. Differs in the male flowers having sepals much longer than the petals.

BEGONIA MEYERI-JOHANNIS, *Engl. Hochgebirgsfl.* 305.

8000 ft. January.

Distrib. Mt. Kilimanjaro.

UMBELLIFERÆ.

SANICULA EUROPÆA, *Linn. Sp. Pl.* 339.

E. 7000 ft. January.

Distrib. Nile Land, Mt. Kilimanjaro, Upper Guinea. Very widely distributed in Europe, Asia, and America.

PEUCEDANUM PETITIANUM, *A. Rich. Tent. Fl. Abyss.* i. 327.

E. 7000 ft. January.

Distrib. of type. Nile Land, Upper Guinea.

Var. *kilimanscharicum*, Engler: Mt. Kilimanjaro.

P. KERSTENI, *Engl. Bot. Jahrb.* xix. *Beibl.* no. 47 (1894), 43.

E. 12,000 ft. February.

Distrib. Mt. Kilimanjaro.

Mr. Wright informs me that "*Peucedanum dissectum*, Dawe, Report, p. 46, is Mr. Dawe's name for the plant described in Sir H. H. Johnston's 'Uganda Protectorate,' i. p. 326, as *Anthriscus dissectus*. The original specimen consisted of leaves and detached fruits, the latter certainly belonging to *Anthriscus*. Specimens sent by Mr. Dawe, No. 598, have the fruits attached and are correctly referred to *Peucedanum*." These latter are very closely allied to the plant collected by Dr. Wollaston.

TORILIS GRACILIS, *Engl. Hochgebirgsfl.* 301.

7000 ft. February.

Also collected by Scott Elliot (No. 6833) at 7000–8000 ft.

Distrib. Mozambique District. And the forma *umbrosa*, Engl.: Mozambique District and Mt. Ruwenzori.

GAMOPETALÆ.

By Spencer Le M. Moore.

The collection includes the following well-known plants :—*Adenostemma viscosum*, Forst., 7000 ft. ; *Ageratum conyzoides*, Linn., 6000 ft. ; *Dichrocephala latifolia*, DC., 6000 ft. ; *Pluchea Dioscoridis*, DC., 3500 ft. ; *Eclipta erecta*, Linn., 3500 ft. ; *Gynura cernua*, Benth., 6000 ft. ; *G. crepidioides*, Benth., 6000 ft. ; *Sonchus asper*, Hill, 3500 ft. ; *Evolvulus alsinoides*, Linn., 3500 ft. ; *Leucas martinicensis*, R. Br., 7000 ft. ; and *Leonotis nepetæfolia*, R. Br., 7000 ft.

RUBIACEÆ.

Pentas purpurea, *Oliver, in Trans. Linn. Soc.* xxix. (1873) 83, var.
E. 6000 ft. January.
Distrib. Nile Land, Mozambique, Lower Guinea.

Pentas pubiflora, sp. nov.

Herbacea, ascendens, caule subtereti sursum ramuloso mox lineis duabus pubescentibus exemptis glabro novellis dense pubescentibus, foliis ovato-lanceolatis lanceolatisve acutis vel caudato-acuminatis basi in petiolum brevem angustatis supra scabriuscule puberulis subtus pubescentibus costis secundariis utrinque 10–13 leviter arcuatis, stipulis a basi setiferis setis pubescentibus, cymis caulem ramulosque terminantibus foliis subæqualibus vel iis brevioribus dense pubescentibus, floribus pro rata parvulis subsessilibus pentameris, calycis dense pubescentis lobis triangulari-deltoideis 2 (vel 1) lineari-lanceolatis quam reliqui multo majoribus, corollæ tubo extus dense pubescente faucibus villosulis lobis tubum haud semiæquantibus lineari-lanceolatis acutis extus dense pubescentibus, staminibus paullo infra fauces insertis filamentis glabris antheris exsertis, disco eminente pubescente, ovario 2-loculo, stylo incluso glabro.

Hab. Ruwenzori E. 6000 ft. January.

Folia modica 6·0–10·0 cm. long., 2·0–3·5 cm. lat, membranacea, subtus grisea. Stipularum setæ circa 0·6 cm. long. Cymæ 5·0–9·0 cm. long., adusque 10·0 cm. diam. Pedicelli circa 0·1 cm. long. Flores albi. Calycis lobi majores circa 0·3 cm. long., reliqui 0·075–0·15 cm. Corollæ tubus sursum leviter amplificatus, intus pubescens, 0·45 cm. long., basi 0·125 cm., faucibus 0·2 cm. diam.; lobi 0·2 cm. long. Filamenta 0·2 cm., antheræ 0·12 cm. long. Ovarium hemisphæricum, dense pubescens, 0·15×0·15 cm. Stylus 0·2 cm., hujus rami 0·1 cm. long. Capsula sparsim pubescens, longitrorsum costata, disco elevato coronata et calycis lobis adusque 0·15–0·4 cm. auctis instructa, in toto 0·3 cm. long, vix totidem lat.

Known from its congeners, among other features, by the very short and densely hairy corollas. The affinity is with *Pentas herbacea*, Hiern, from Golungo Alto.

Var. LONGISTYLA. Corollæ paullo breviores (0·5 cm. long.) necnon extus paullulum minus pubescentes. Antheræ subsessiles, inclusæ. Stylus exsertus, cum stigmate 0·6 cm. long.

Hab. Ruwenzori E. 7000 ft. January.

Apparently a long-styled form of the species.

PAVETTA RUWENZORIENSIS, sp. nov.

Arbuscula ramulis validis tetragonis pubescentibus dein puberulis novellis albo-hirsutulis, foliis sat amplis ellipticis apice cuspidato-acuminatis ipso obtusiusculis basi in petiolum piloso-pubescentem longe sensimque angustatis membranaceis utrobique præsertim vero fac. inf. puberulis costis secundariis utrinque 11–12 patulis sub margine subito arcuatis, stipulis inferne longe cuneatis dorso pubescentibus superne lineari-subulatis pilosis, corymbis axillaribus sublaxe multifloris pedunculis longis validis erecto-ascendentibus mox minute puberulis fultis, floribus 4-meris, pedicellis puberulis quam calyx brevioribus, calycis tubo (ovario) subsphæroideo puberulo limbo ultra ovarium longiuscule producto ut lobi lineari-subulati glabro, corollæ tubo elongato intus piloso-puberulo lobis oblongis obtuse acutis tubum plus quam semiæquantibus, filamentis brevibus crassiusculis antheris exertis, stylo corollam longe excedente crassiusculo puberulo, stigmate anguste fusiformi integro, bacca maxime cruda reliquiis calycis limbi exuti coronata.

Hab. Ruwenzori E. 7000 ft. January. (Also Ruwenzori, 7000–8000 ft., Scott-Elliot, 7833; and Uganda, *id.*, 7399.)

Folia adulta 12·0–14·0 cm. long., 5·5–7·0 cm. lat., in sicco olivacea; costæ ord. sec. tenues, pag. sup. planæ, pag. inf. eminentes; petioli circa 2·0 cm. long. Stipularum pars connata 0·4–0·5 cm. long., harum pars libera 0·4 cm. long. Pedunculus circa 14·0 cm. long. Pedicelli 0·2–0·5 cm. long. Corymbi circa 10·0 cm. diam. Flores albi. Ovarium 0·2 cm. long. Calycis limbus in toto 0·8–0·9 cm.; lobi circa 0·05 cm. long. Calycis reliquiæ baccam coronantes circiter 0·05 cm. long. Corollæ tubus 1·85 cm. long., 0·2 cm. diam.; lobi circa 1·0 cm. long., 0·3 cm. lat. Filamenta 0·13 cm. long.; antheræ lineares, tortæ, 0·85 cm. long. Stylus 4·7 cm. long.

Known by the elliptical pilose-puberulous leaves, the long stout axillary peduncles, the calyces with relatively long glabrous limb and lobes leaving a distinct rim behind them upon their detachment, which appears to happen immediately after opening of the flower, and the long puberulous styles with narrowly fusiform stigma.

GRUMILEA MEGISTOSTICTA, sp. nov.

Arbor ramulis compressis crebro foliosis cortice sulcato mox circumdatis diuscule glabris novellis pubescentibus, foliis breviter petiolatis oblongo-ovatis cuspidato-acuminatis apice acutis basi obtusis leviterve rotundatis papyraceis supra glabris subtus in costa media et costulis piloso-hirsutulis in axillis costarum secundariarum glandula (domatio) pellucida maxima onustis utrobique opacis fac. inf. vero pallidioribus, stipulis late ovatis obtusis integris extus minute pubescentibus cito deciduis, floribus in cymis paucifloris abbreviatis minute pubescentibus paniculam brevem (sc. a foliis longe superatam) efformantibus digestis, bracteis brevissimis ovatis, pedicellis quam ovarium brevioribus, ovario subsphæroidali fulvo-pubescente, calyce ovarium excedente leviter dentato dentibus triangularibus obtusis fere glabro, corollæ tubo basi angustato inde dilatato extus pubescente intus villoso in lobos 4 vel 5 oblongos obtusos cito reflexos utrinque minute puberulos semidiviso, staminibus exsertis, stylo breviter exserto ramis oblongis obtusis quam se ipse brevioribus, bacca ——.

Hab. Ruwenzori E. 7000 ft. January.

Arbor sec. cl. collectorem circa 12-metralis ("30–40 ft. high").

Folia solemniter 7·0–10·0 × 3·5–5·0 cm.; costæ secundariæ utrinque 9–11, patentes, juxta marginem dichotomæ, utrinque præsertim attamen pag. inf. eminentes; glandulæ axillares ellipticæ, 0·15 × 0·1 cm., quæque a costa sua secundaria subito decurva marginata; petioli ±1·0 cm. long., raro 2·0 cm. Stipulæ fere 1·0 cm. long. Panicula 3·0 cm. long. Pedicelli incrassati, 0·05 cm. long. Flores albi. Ovarium 0·1 cm., calycis limbus totus 0·175 cm., hujus lobi 0·025–0·05 cm. long. Corolla in toto 0·7 cm. long.; tubus 0·35 cm., humectatus basi 0·1 cm., faucibus 0·3 cm. diam.; lobi 0·35 cm. long., fac. sup. prominule 1-nervosi. Filamenta paullo infra fauces inserta, 0·25 cm. long.; antheræ late oblongæ, 0·13 cm. long. Stylus vix 0·4 cm. stigmatis rami 0·12 cm. long.

Although without fruit, this seems to be a *Grumilea* rather than a *Psychotria*. It is known at sight by the extremely large gland-like domatia in the axils of the secondary nerves.

DIODIA STIPULOSA, *S. Moore, in Journ. Linn. Soc., Bot.* xxxvii. (1905) 310.

E. 7000 ft. January.

Distrib. Nile Land and Upper Guinea.

GALIUM SERRATOHAMATUM, sp. nov.

Herbaceum, ramis sat elongatis gracilibus hispidulo-scabridis infra nodos hispidis ipsos ad nodos pilis longis arrectis ferrugineis onustis, foliis pro verticillo 6 sessilibus oblongis vel oblongo-linearibus apice breviter spinulosis ima basi leviter angustatis margine serratis serraturis retrorso-

spinulosis uninervibus in sicco nigrescentibus, floribus viridibus 4-meris in cymis abbreviatis (sc. quam folia brevioribus) 2–4-floris ramulos breves laterales terminantibus et a foliis parvis 1–4-bracteatis dispositis, pedicellis ovarium æquantibus vel eo brevioribus longioribusve, ovario oblate sphæroideo glabro vel fere glabro, fructu parvo subsphæroideo glabro vel sparsim hispidulo.

Hab. Ruwenzori E. 12,500 ft. February.

Folia ± 1·0 cm. long., 0·2–0·3 cm. lat., firme membranacea, in sicco marginibus plerumque revolutis; spinula terminalis circa 0·1 cm. long., sæpe uncinata; serraturæ adusque 0·03 cm. alt. Cymæ cum ramulo suffulciente circa 0·5 cm. long., hispidulæ. Pedicelli 0·025–0·1 cm. long. Ovarium 0·05 × 0·075 cm. Flores circa 0·25 cm. diam. Corollæ lobi oblongi, scabriusculi, 0·15 cm. long. Filamenta 0·05 cm., antheræ 0·025 cm. long. Fructus 0·12 × 0·1 cm.

Distinguished from varieties of *G. Aparine*, Linn., by the leaves with distinctly serrated margins, the short inflorescences, and small fruits.

COMPOSITÆ.

Erlangea marginata, *S. Moore, in Journ. Linn. Soc., Bot.* xxxv. (1902) 310.

E. 7000 ft. January.

Distrib. Nile Land, Mozambique District.

Vernonia (§ Lepidella) Wollastoni, sp. nov.

Herbacea, caule erecto verisimiliter rariramoso bene folioso pluristriato parce pubescente novellis dense fulvo-pubescentibus, foliis parvis brevipetiolatis lanceolatis acuminatis basi acutis margine distanter serrulatis serraturis induratis vulgo arrectis membranaceis pag. sup. cito costis puberulis exemptis glabris pag. inf. ad costas appresse pubescentibus alibi glandulis minimis sessilibus perlucentibus onustis, capitulis parvis 12-flosculosis in corymbum terminalem folia excedentem laxum pluricephalum raribracteatum digestis, bracteis folia mentientibus sed iis plerumque minoribus, involucri graciliter pedunculati campanulati pubescentis 3-serialis phyllis extimis subulatis quam interiora lanceolata acuminata in sicco dilute straminea plane brevioribus, flosculis ex involucro longe eminentibus, achæniis cylindricis 5-costatis piloso-pubescentibus necnon glandulis minimis lucentibus instructis, pappi setis scabriusculis albis achænia 2-plo excedentibus squamellis brevibus angustissime linearibus glabris.

Hab. Ruwenzori E. 7000 ft. January.

Folia solemniter 4·0–6·0 cm. long., 1·2–1·5 cm. lat., accedunt alia multo minora ex ramulis juvenilibus abbreviatis orta; costæ secundariæ utrinque circa 8, parum arcuatæ, pag. sup. planæ, pag. inf. paullo

eminentes; petioli circa 0·5 cm. long., pubescentes. Corymbus 7·0–10·0 × 12·0–14·0 cm.; hujus bracteæ 2·0–4·0 cm. long. Pedunculi proprii sæpius 1·0–1·5 cm. long., rarissime adusque 0·2 cm. imminuti, pubescentes. Involucrum 0·6 cm. long., 0·65 cm. diam.; phylla extima circa 0·2 cm., interiora 0·55 cm. long., hæc subscariosa, 3-nervia (intima vero sæpe 1-nervia). Corollæ extus sparsissime glandulosæ tubus superne leviter ampliatus, 0·6 cm. long.; lobi anguste oblongi, 0·3 cm. long. Styli rami circa 0·2 cm. long. Achænia 0·3 cm. long.; pappi setæ 0·6–0·7 cm. long.; squamellæ 0·05–0·075 cm. long.

Nearest *V. syringæfolia*, O. Hoffm., a species which Dr. Hoffmann refers to § *Cyanopis*, although the outer pappus seems to me to be of squamellæ, though very narrow ones. From this it differs entirely in leaf, also in the smaller heads with only half the number of florets, the pubescent involucres, &c. *V. Biafræ*, Oliver & Hiern, referred in the 'Flora of Tropical Africa' to § *Lepidella* although its squamellæ are no wider than those of *V. syringæfolia*, is also closely allied to the new plant, but, *inter alia*, its involucres are quite different.

VERNONIA CINERASCENS, *Sch. Bip. in Schweinf. Fl. Aethiop.* 162.
S.E. 3000 ft. June.
Distrib. Nile Land, Lower Guinea.

V. RUWENZORIENSIS, *S. Moore, in Journ. Linn. Soc., Bot.* XXXV. (1902) 321.
7000 ft. January.
"A shrub 5–10 ft. high. Flowers white."
Distrib. Restricted to Ruwenzori.

CONYZA SCARIOSA, sp. nov.

C. caule gracili crebro foliato longitrorsum pluristriato cito glabrescente, foliis sessilibus lineari-oblongis vel anguste oblanceolato-linearibus acutis basi brevissime amplexicaulibus margine distanter serrulatis membranaceis supra glabris subtus in nervis margineque leviter hispidulis, capitulis mediocribus multifloseulosis in corymbum terminalem sparsim bracteatum folia longe excedentem laxiusculum digestis, pedunculis propriis gracilibus involucrum excedentibus vel subæquantibus minute pubescentibus, involucri hemisphærici glabri vel summum leviter puberuli 3-serialis phyllis oblongo-obovatis obtusissimis margine apiceque late scariosis longitrorsum plurinervosis extimis quam interiora brevioribus, receptaculo convexiusculo foveolato foveolis fimbrilliferis, flosculis fem. multiseriatis hermaph. pluribus albis, flosculorum fem. corollis apice denticulatis nequaquam ligulatis, achæniis oblongis com-

pressis glabris, pappi setis achænia longe excedentibus 1-seriatis scabridis sordide albis.

Hab. Ruwenzori E. 7000 ft. January.

Folia modice 2·5–3·0 cm. long., ± 0·5 cm. lat., costæ costulæque (pag. inf. magis aspectabiles) eleganter reticulatæ. Corymbi circa 10·0 cm. long., summum 8·0 cm. diam. Bracteæ foliaceæ, lineares, 0·05–0·2 cm. long., summæ angustissimæ. Pedunculi proprii solemniter 0·5–1·0 cm. long. Involucrum 0·6 × 0·6 cm.; phylla extima 0·4 cm. long., intermedia circa 0·55 cm., hæc adusque 0·25 cm. lat.; pauca adsunt intimæ circa 0·15 cm. lat., omnia in sicco dilute brunnea. Flosculorum fem. corollæ circa 0·15 cm. long., flosculorum hermaph. 0·4 cm. long., horum lobi 0·1 cm. long. Achænia 0·1 cm., pappus 0·35 cm. long.

At once distinguished from its African congeners by the broad very obtuse scarious leaves of the involucre.

CONYZA MONTIGENA, sp. nov.

C. caule gracili subtereti crispe pubescente cito glabro longitrorsum striato brunneo-rubescente, foliis sessilibus lanceolato-oblongis breviter acuminatis basi leviter amplexicaulibus margine integris vel hinc illinc denticulatis membranaceis utrinque glabris, capitulis pro rata mediocribus multiflosculosis in corymbo terminali paucibracteato polycephalo folia æquante vel leviter excedente dispositis, pedunculis propriis involucrum excedentibus gracilibus pubescentibus, involucri hemisphærici 3-serialis phyllis lineari-lanceolatis (intimis angustioribus) acuminatis uninervibus subscariosis, receptaculo convexiusculo foveolato foveolis fimbriliiferis, flosculis fem. pauciserialibus hermaph. complurimis flavicantibus, flosculorum fem. corollis breviter ligulatis ligula a stylo plane superato, achæniis adhuc crudis oblongis (basi vero leviter angustatis) compressis sericeo-puberulis, pappi setis 1-seriatis sordide albis scabriusculis.

Hab. Ruwenzori E. 11,000 ft. February.

Folia 2·0–4·5 cm. long., 0·7–1·3 cm. lat., pag. inf. pallidiora, eleganter reticulata. Corymbus 2·5–5·0 cm. long., 4·0–6·0 cm. diam. Bracteæ lineares vel lineari-oblongæ, ± 0·5 cm. long. Pedunculi proprii modice 0·5–1·0 cm. long. Involucrum 0·6 × 0·7–0·8 cm.; phylla ± 0·55 cm. long., intermedia 0·15 cm., intima 0·1 cm. lat. Flosculorum fem. corollæ tubus 0·2 cm. long.; ligula 0·1 cm. long. Flosculorum hermaph. corollæ in toto 0·4 cm. long.; lobi vix 0·1 cm. long. Achænia 0·1 cm., pappus 0·4 cm. long.

The flowering heads are much like those of *C. gigantea*, O. Hoffm., except for the presence of the distinct though short ligule to the outer florets. In addition the leaves of the two are very different, and whereas the heads of *C. gigantea* are closely compacted, those of *C. montigena*, besides being fewer, are much more laxly arranged.

LAGGERA ALATA, *Sch. Bip. ex Oliver, in Trans. Linn. Soc.* xxix. (1873) 94, var. DENTATA, var. nov. Differs only from some of the more hairy forms of the species in the toothed wings to the stem.

E. 6000 ft. January.

Distrib. Common (the type) in tropical and subtropical Africa. Also a Mascarene and tropical Asian species.

HELICHRYSUM (Argyreia § Elegantissima) ARGYROCOTYLE, sp. nov.

Herbacea, caule erecto forsan simplici tereti fistuloso araneoso-puberulo vel pubescente crebro folioso, foliis mediocribus sessilibus lanceolatis vel lanceolato-oblongis apice mucronatis basi obtusis leviterve rotundatis uninervibus membranaceis supra scabriusculis subtus pubescentibus, capitulis mediocribus homogamis multiflosculosis in corymbo terminali laxo pluricephalo bracteato folia excedente vel æquante araneoso-pubescente ordinatis, bracteis foliaceis junioribus imminutis, involucri hemisphærici multiserialis phyllis extimis comparate brevibus interioribus gradatim longioribus lamina sat elongata lineari-lanceolata (phyll. intimorum lineari) acuminata radiante nitente instructis, receptaculo plano alveolato nudo, flosculis inclusis, corollis 5-lobis, antherarum caudis sparsim setaceo-ramosis, styli ramis apice subcapitatis, achæniis cylindricis glabris, pappi setis uniserialibus scabridis sordidis.

Hab. Ruwenzori E. 10,000 ft. February.

Planta saltem 30·0 cm. alt. Pili glandulosi in omnibus partibus pubigeris cum simplicibus plus minus intermixti. Folia radicalia desunt ; caulina inferiora 7·5 × 2·0 cm., superiora 3·0–6·0 cm. long., 1·2–1·8 cm. lat. Corymbi 4·0–10·0 cm. long., 8·0–15·0 cm. diam. Bracteæ sæpissime 0·7–2·5 cm. long., plerumque lineares vel lineari-lanceolatæ, sursum attenuatæ, araneoso-puberulæ. Pedunculi proprii solemniter 2·5–3·5 cm. long., patentes. Capitula 1·25 × 1·5 cm. Involucri phylla extima basi araneosa, 0·6–0·7 cm. long. ; intermedia 0·85–0·9 cm., intima 1·0–1·1 cm. long. Receptaculum 0·5 cm. diam. Corollæ 0·25 cm. long. Antherarum loculi 0·8 cm., caudæ 0·3 cm. long. Achænia ægre 0·1 cm., pappus 0·3 cm. long.

Near *H. elegantissimum*, DC. (*H. formosissimum*, Sch. Bip.), from which it is easily distinguished by the smaller leaves, the smaller heads with more pronouncedly acuminate involucral leaves, and the small corollas.

To this is to be referred Scott Elliot's No. 8010 (Ruwenzori, 9000–10,000 ft.), which I formerly (Journ. Linn. Soc., Bot. xxxv. (1902) 333) named "*H. elegantissimum*, DC."

HELICHRYSUM (Argyreia § Elegantissima) WOLLASTONI, sp. nov.

H. caule erecto crebro folioso dense albo-araneoso lanuginoso, foliis sessilibus lanceolato-oblongis apice mucronatis uninervibus chartaceis supra laxe

araneosis tandem verisimiliter glabris subtus densissime dilutissime fulvo-floccoso-tomentosis, capitulis mediocribus multiflosculosis heterogamis in corymbo brevi racemiformi paucicephalo satis laxo bracteato dense lanuginoso dispositis, pedunculis propriis quam capitula brevioribus vel ea subæquantibus dense lanuginosis, bracteis foliis similibus nisi minoribus, involucri late ovoidei pluriseriati phyllis interioribus gradatim longioribus extimis lamina ovato-lanceolata intermediis lanceolata intimis lineari-oblonga coronatis omnibus acutis tandem radiantibus exterioribus purpureis interioribus argyreis nitentibus, receptaculo plano nudo alveolato, flosculis paucis extimis femineis, corollis 5-lobis, antherarum caudis simplicibus, styli ramis subcapitatis, achæniis cylindricis (ima basi dilatatis) glabris, pappi setis paucis 1-serialibus scabridis albis.

Hab. Ruwenzori E. 12,000 ft. February.

Speciminis unici mihi obvii caulis simplex, 24·0 cm. alt., robustus (sc. basi 0·8 cm. lat.), in sicco prominenter striatus. Folia 4·5–8·0 cm. long., 1·0–1·7 cm. lat., summa in bracteas transeuntia. Corymbus 6·0 × 6·0 cm. Bracteæ ± 1·5 cm. long. (infimæ fere adusque 4·0 cm.), araneosæ. Pedunculi proprii patentes, 1·0–2·0 cm. long. Capitula 1·8 × 1·2 cm. Involucri phylla extima 0·8–0·9 cm., intermedia 1·0–1·1 cm., intima 1·2 cm. long. Receptaculum 0·5 cm. diam. Corollæ 0·25 cm. long. Antherarum loculi 0·075 cm., caudæ 0·05 cm. long. Achænia (adhuc cruda) 0·065 cm. long. ; pappi setæ 0·35 cm. long.

In leaf intermediate between *H. Gulielmi*, Engl., and *H. Lentii*, Volk. & O. Hoffm. It differs from both in the racemiform inflorescence and the shorter, more sphæroidal heads with shorter and relatively broader involucral leaves. The three, when more specimens are forthcoming, may perhaps be considered forms of a single polymorphic species.

HELICHRYSUM STUHLMANNI, *O. Hoffm. in Engl. Bot. Jahrb.* xx. (1894) 232.
E. 13,000 ft. February.

H. STUHLMANNI, *O. Hoffm.*, var. LATIFOLIUM, var. nov. Folia quam ea typi insigniter breviora necnon latiora, sc. circa 2·5 × 0·6–0·7 cm.

E. 14,800 feet.

Though at first sight very different in foliage and decidedly more woolly, apparently a high-level variety and not a distinct species.

Distrib. So far the species is known only from Ruwenzori and Kilimanjaro.

H. FŒTIDUM, *Moench, Method.* 575.

E. 6000 ft. January.

Distrib. Nile Land and Mozambique District. Also South Africa.

HELICHRYSUM SETOSUM, *Harv. in Fl. Cap.* iii. 231.

E. 7000 ft. January.

Distrib. Nile Land, Mozambique District. Also South Africa.

MELANTHERA BROWNEI, *Sch. Bip. in Flora*, xxvii. (1844) 673.

6000 ft., January ; and 5000 ft., March.

Distrib. Widely distributed through tropical Africa. Also a South-African plant.

GUIZOTIA COLLINA, sp. nov.

Herbacea, caule erecto gracili distanter folioso scabride hispidulo tandem fere glabro, foliis sessilibus lineari-oblongis obtusis basi sæpe levissime amplexicaulibus margine serrulatis coriaceis pag. sup. scaberrimis inf. scabro-hispidulis, capitulis in cymis brevibus paucicephalis terminalibus vel ramulos sparsim foliosos coronantibus hispidis dispositis, pedunculis propriis quam capitula brevioribus, involucri phyllis exterioribus herbaceis elongatis lineari-lanceolatis obtusis (apice callosis) hispidis quam phylla interiora lanceolato-oblonga acuta dorso sparsim hispidulo-pilosa multo longioribus, ligulis 12 oblongo-obovatis apice 3-dentatis 9-nervosis, disci corollis basi tomentosis, achæniis (nondum maturis) tetragonis glabris.

Hab. Ruwenzori E. 5000 ft. March.

Folia 4·0–9·0 cm. long. ; circa 1·0 cm. lat. ; marginibus in sicco sæpissime revolutis, fac. inf. pallida. Cymæ 2·0–4·0 cm. long. Pedunculi proprii 0·2–1·5 cm. long., hispidi. Involucri phylla exteriora 1·5 cm. long., $\pm$ 0·3 cm. lat. ; interiora 3-nervia, 0·5 × 0·25 cm. Receptaculi paleæ anguste oblongo-obovatæ, apice truncato-rotundatæ, 3-nerves, 0·6 cm. long. Ligulæ 1·2 cm. long., summum 0·5 cm. lat. Disci corollæ 0·4 cm. long. Achænia 0·2 cm. long. vel paullulum longiora.

Known by the hispid and scabrous clothing of various organs, the narrow undivided leaves, the narrow and relatively elongated outer involucral leaves, &c.

COREOPSIS ABYSSINICA, *Sch. Bip. ex Walp. Rep.* vi. 163.

E. 7000 ft. January.

Distrib. A Nile Land plant.

GYNURA RUWENZORIENSIS, *S. Moore.* (*Crassocephalum ruwenzoriense*, S. Moore, in Journ. Linn. Soc., Bot. xxxv. (1902) 352.)

E. 6000-7000 ft. January.

Distrib. Restricted to Ruwenzori.

SENECIO MULTICORYMBOSUS, *Klatt, in Ann. Naturh. Hofmus. Wien*, vii. (1892) 103.
E. 7000 ft. March.
Distrib. East and West tropical Africa.

S. SYCEPHYLLUS, *S. Moore, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 324.
E. 12,000 ft. February.
Distrib. Restricted to Ruwenzori.

S. ADNIVALIS, *Stapf, in Journ. Linn. Soc., Bot.* xxxvii. (1906) 521.
E. 12,000 ft. February.
Distrib. Restricted to Ruwenzori.

SENECIO GYNUROIDES, sp. nov.

Elatus, caule subtereti striato glabro vel summum obscure puberulo, foliis lanceolato-oblongis breviter acuminatis e basi rotundata subito in petiolum brevem acuminatis margine calloso-dentatis membranaceis supra glabris subtus appresse pilosulis petiolis auriculis duabus late ovatis sparsim dentatis instructis, capitulis mediocribus homogamis discoideis multiflosculosis in corymbo terminali subsessili subumbellato perpaucicephalo raribracteato digestis, bracteis parvis linearibus, pedunculis propriis arrectis elongatis sc. capitula magnopere excedentibus brunneo-puberulis, involucri subhemisphærici glabri phyllis 20 anguste lineari-oblongis breviter acuminatis anguste marginatis additis calyculi phyllis pluribus lineari-subulatis ut involucri phylla microscopice puberulis, flosculis exsertis, antheris basi vix auriculatis, styli ramis truncatis appendice filiformi brevissimo onustis, achæniis cylindricis 10-costatis albo-setosis, pappi setis glabris albis.

Hab. Ruwenzori E. 12,500 ft.

Planta ex schedis cl. detectoris "10–15 ped." alt. Foliorum limbus 10·0 cm. long., summum 3·0–3·5 cm. lat., in sicco castaneo-olivaceus; costæ secundariæ utrinque circa 10, ascendentes; costularum rete delicatulum, pag. inf. solum aspectabile; petioli basi dilatati, circa 1·0 cm. long., horum auriculæ 0·8 × 0·7 cm. Pedunculi proprii 5·5 cm. long. Bracteæ ±0·5 long. Involucrum 1·0 × 1·2 cm.; calyculi phylla circa 0·6 cm. long., raro 1·0 cm. attingentia. Flosculi lutei. Corollarum tubus superne gradatim dilatatus, 0·9 cm. long., inferne vix 0·02 cm., faucibus 0·15 cm. diam.; lobi triangulares, 0·12 cm. long. Antheræ inclusæ. Styli rami vix 0·2 cm., appendix 0·02 cm. long. Achænia fere 0·2 cm., pappus 0·9 cm. long.

Near *S. macropappus*, Sch. Bip., which has different leaves and inflorescences, a different calyculus (*i. e.* leaves longer and relatively much narrower), larger corollas, &c.

Senecio jugicola, sp. nov.

S. caule erecto robusto angulato pluristriato rariramoso brunneo-pubescente demum scabriusculo, foliis petiolatis lanceolato-oblongis acutis obtusisve basi rotundatis margine serrato-dentatis summis perpaucis imminutis et in bracteas transeuntibus supra costa media puberula neglecta glabris subtus laxe necnon appresse piloso-pubescentibus, corymbo foliis subæquilongo polycephalo patulo pubescente, bracteis parvis lineari-subulatis puberulis, capitulis parvis heterogamis radiatis circa 25-flosculosis pedunculis quam sese nunc paullo longioribus nunc brevioribus fultis, calyculi phyllis perpaucis abbreviatis subulato-linearibus, involucri turbinato-cylindrici puberuli phyllis 8 oblongis infra apicem angustatis apice ipso acutis nunc angustissime nunc latius marginatis, ligulis 6 ex involucro eminentibus late oblongis 3-dentatis 4-nervibus luteis, disci corollis exsertis, styli ramis truncatis penicillatis, achæniis (hucusque crudis) cylindrico-turbinatis aliquanto compressis 10-costatis glabris, pappi setis scabriusculis albis.

Hab. Ruwenzori E. 9000 ft. February.

Folia matura ±10·0 cm. long. et 4·0 cm. lat., papyracea; costæ secundariæ utrinque 12–15, ut costa centralis pag. inf. magis perspicuæ, paullulum arcuatæ; petioli 1·0–1·5 cm. long., araneoso-pubescentes. Corymbus circa 10·0 × 12·0 cm.; ramuli adusque 2·5 cm. long. Bracteæ ±0·5 cm. long. Pedunculi proprii sæpissime 0·2–0·5 cm. long. Involucrum ægre 0·5 cm. long. Calyculi phylla vix 0·15 cm. long., margine lanuginosa. Radii corollarum tubus 0·3 cm. long.; ligula 0·3 × 0·15 cm. Disci corollarum tubus sursum leviter ac gradatim amplificatus, 0·4 cm. long.; lobi 0·075 cm. long., oblongi, obtusi. Antheræ subinclusæ, basi obscurissime auriculatæ. Styli rami 0·1 cm., achænia 0·1 cm., pappus 0·45 cm. long.

The description of *S. scrophulariifolius*, O. Hoffm., a plant not seen by me, reads somewhat like, but its leaves are different in shape, margin, and clothing, the capitula have fewer florets, &c.

Senecio Wollastoni, sp. nov.

S. caule angulato pluristriato glabrescente distanter folioso foliis (paucis superioribus solummodo visis) sessilibus lanceolatis vel lanceolato-oblongis obtuse acutis basi distincte angustatis margine dupliciter serrato-dentatis membranaceis supra glabris subtus tenuiter araneosis mox glabrescentibus costis secundariis utrinque adusque 20, capitulis mediocribus heterogamis circa 30-flosculosis in corymbo terminali laxo pluricephalo leviter araneoso bracteato digestis, pedunculis propriis gracilibus capitula bene excedentibus, bracteis parvis lineari-setaceis araneosis, calyculi phyllis paucis parvis anguste lineari-lanceolatis acutis araneosis, involucri campanulati levissime araneosi phyllis 13 oblongis sursum deltoideis apice

acutis sphacelatis et puberulis margine membranaceis, ligulis 6–8 anguste lineari-oblongis comparate elongatis, disci corollis breviter exsertis, styli ramis truncatis penicillatis, achæniis exterioribus compressiusculis interioribus cylindricis 5-costatis glabris, pappi setis scabridis albis.

Hab. Ruwenzori E. 7000 ft. January.

Caulis exempll. duorum a me scrutatorum 0·3–0·4 cm. diam., hinc inde reliquiis pubis araneosæ instructus ceteroquin glaber, ex axillis gemmam brevissimam dense albo-araneoso-tomentosam sæpe efferens. Folia 9·0–14·0 cm. long., 2·0–4·5 cm. lat., perpauca summa minora; costæ secundariæ pag. inf. magis aspectabiles, angulis variis costæ centrali supra impressæ, subtus admodum prominenti insertæ, sæpe undulatæ, paullulum arcuatæ; costulæ arcte reticulatæ. Corymbi circa 10·0 × 10·0–12·0 cm. Bracteæ ±0·5 cm. long. Pedunculi proprii 1·0–3·0 cm. long. Calyculi phylla 0·2 cm. long. Involucrum 0·8 cm. long, summum 0·6 cm. diam. Ligula (limbus) 1·0 cm. × 0·225 cm., apice obscure 3-denticulata, 4-nervis. Disci corollarum tubus sursum subito dilatatus, pars attenuata 0·4 cm., pars dilatata 0·325 cm. long.; lobi vix 0·15 cm. long. Antheræ exsertæ, obscure auriculatæ. Styli rami puberuli, 0·12 cm. long. Achænia 0·2 cm., pappus 0·8 cm. long.

To be inserted in the genus next *S. ochrocarpus*, Oliver & Hiern, and *S. denticulatus*, Engl. Easily distinguished from both, *inter alia*, by the leaves distinctly narrowed at base, and without an araneose tomentum on the underside, and the much longer and relatively narrower ligules.

SONCHUS BIPONTINI, *Aschers. in Schweinf. Beitr. Fl. Aethiop.* 160.
S.E. 3500 ft. June.

Var. PINNATIFIDUS, *Oliver & Hiern, in Fl. Trop. Afr.* iii. 458.
E. 6000 ft. January.
Distrib. (of type and variety). East tropical Africa.

LACTUCA ABYSSINICA, *Fres. in Mus. Senckenb.* iii. (1839) 72.
E. 7000 ft. January.
Distrib. Nile Land.

CAMPANULACEÆ.

(E. G. BAKER.)

LOBELIA (§ Rhynchopetalum) WOLLASTONI, sp. nov.

Planta gigantea; foliis tenuiter coriaceis sessilibus late linearibus circ. 8–9-plo longioribus quam latis utrinque glaberrimis (adultioribus) margine tenuissime serrulatis apice acutis costa crassa in sicco albicante instructis nervis lateralibus numerosis superne insculptis subtus subprominentibus et reticulatis pallidioribus; racemo dense bracteato, bracteis lineari-lanceolatis margine dense pilosis apice acuminatissimis flore aperto circ

1½plo longioribus; pedicellis tenuibus brevibus; calycis tubo campanulato extus piloso laciniis lineari-lanceolatis quam tubo subtriplo longioribus quam petalis subduplo brevioribus margine pilosis; corolla secus cl. detectorem cœrulea; filamentis pubescentibus quam antheris atro-violaceis circ. 2½plo longioribus, antheris 2 anterioribus tenuiter barbatis; stylo infra stigma dense piloso.

Species *Lobelia Telekei*, Schweinf., affinis, differt bracteis circ. 1½plo quam floribus longioribus haud florem decies superantibus, floribus majoribus, foliis glabris. Ab *L. Rhynchopetalo* differt bracteis angustioribus pilosioribus et calycis laciniis brevioribus.

Hab. Ruwenzori E. 12,500–14,500 ft.

Blue spike 10–15 ft.; dried leaves cling to the lower part of the stem. In flower April 3, 1906.

Folia in specimine nostro ±25 cm. longa et 3·0 cm. lata. Bracteæ ±6·5 cm. longæ. Flores ±4·5 cm. longæ. Calycis tubus ±5 mm. longus, laciniæ ±1·6 cm. longæ. Petala ±3·6 cm. longæ. Filamenta 2·4 cm. longa. Antheræ ±1·0 cm. longæ. Stylus ±2·5 cm. longus.

Mr. Dawe (in Journ. Linn. Soc., Bot. xxxvii. 538, 539) records four species of *Lobelia* Sect. *Rhynchopetalum* as occurring on Mt. Ruwenzori, *L. Gibberoa* from 6–7000 ft., *L. Stuhlmanni* from 9800–11,000 ft., *L. Deckenii* 11,000 ft., and *L. Rhynchopetalum* from about 12,000 ft. up to the glaciers.

The plant here described is probably identical with the last of these from Mt. Ruwenzori, but it seems to differ in certain particulars from the *L. Rhynchopetalum* of the high mountains of Abyssinia, and I have therefore ventured to separate it.

In addition to the above, Dr. Engler records (Pflanzenw. Ost-Afr. C. 401) *L. Telekei* from Mt. Ruwenzori at 3800 metres.

LOBELIA (§ Rhynchopetalum) STUHLMANNI, *Schweinf. in Emin Pascha, Im Herz von Afrika*, 291, Taf. 11 (1893) (nomen); *et ex Engl. Pflanzenw. Ost-Afr.* C. 401 (nomen).

F. 10,000–12,000 ft. April.

"Blue spike about 15 ft." Leaves fall off lower part of stem.

Dr. Gilg informs me this agrees with the specimens at Berlin. I have made the following notes on the flowers:—

Bracteæ lanceolatæ acuminatissimæ quam flores parum longiores sæpe 5·0–6·0 cm. longæ, oculo nudo glabræ sub lente margine tenuiter ciliolatæ; calycis tubus campanulatus ±3·5 mm. longus, laciniæ anguste lanceolatæ quam corolla breviores ±2·2 cm. longæ: petala ±3 cm. longa. Antheræ atro-violaceæ 1·1 cm. longæ. Filamenta ±5 mm. longa verisimiliter tandem multo longiora.

ERICACEÆ.

Erica arborea, *Linn. Sp. Pl.* 353.
9000–10,000 ft. February.
Distrib. Nile Land. Also Mediterranean Region and the Comoro Islands.

PRIMULACEÆ.

Lysimachia africana, *Engl. Pflanzenw. Ost-Afr.* C. 304.
E. 7000 ft. January.
Flowers purple (pale lilac, *Engler*; white?, *Pax & Knuth*).
Distrib. Nile Land, Mozambique District. Also Transvaal.

PLUMBAGINEÆ.

Plumbago zeylanica, *Linn. Sp. Pl.* 151.
S.E. 3500 ft. June.
Distrib. Common in old world tropics.

OLEACEÆ.

Jasminum Schimperi, *Vatke, in Linnæa,* xl. (1876) 210.
S.E. 3500 ft. June.
Distrib. Abyssinia.

ASCLEPIADEÆ.

Asclepias semilunata, *N. E. Br. in Dyer, Fl. Trop. Afr.* iv. Sect. 1, 327.
E. 7000 ft. January.
Distrib. Nile Land, Congo Free State, Lower Guinea.

Schizoglossum eximium, *N. E. Br. in Dyer, Fl. Trop. Afr.* iv. Sect. 1, 370.
S.E. 3500 ft. May.
So far as known, restricted to the neighbourhood of Ruwenzori.

CONVOLVULACEÆ.

(Dr. A. B. Rendle.)

Ipomœa calycina, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* iv. 201.
S.E. 3500 ft. May.
Distrib. Tropical and South Africa; India.

I. Wightii, *Choisy, in DC. Prod.* ix. 364.
S.E. 3500 ft. June.
Distrib. East tropical and South Africa, Madagascar and tropical Asia.

BORRAGINEÆ.

Cynoglossum geometricum, *Baker & C. H. Wright, in Dyer, Fl. Trop. Afr.* iv. Sect. 2, 52.
E. 7000 ft. January.
Distrib. South Nile Land and Nyasaland.

SOLANACEÆ.

Solanum runsoriense, *C. H. Wright, in Johnston, Uganda Protectorate*, i. 326.
E. 10,000 ft. February.
Not known except from Ruwenzori.

S. aculeastrum, *Dun. in DC. Prod.* xiii. i. 366.
E. 7000 ft. February.
Distrib. Mozambique district. Also in South Africa.

Discopodium penninervium, *Hochst. in Flora*, xxvii. (1844) 22.
E. 7000 ft. January.
Distrib. Nile Land, Nyasaland, and Upper Guinea.

SCROPHULARIACEÆ.

Craterostigma plantagineum, *Hochst. in Flora*, xxiv. (1841) 669.
S.E. 3500 ft. June.
Distrib. East tropical Africa, Lower Guinea.

Alectra communis, *Hemsl. in Dyer, Fl. Trop. Afr.* iv. Sect. 2, 372.
E. 7000 ft. February.
Distrib. British East Africa and Uganda, Nyasaland, Upper Guinea.

Rhamphicarpa Herzfeldiana, *Vatke, in Linnæa*, xliii. (1880–82) 311.
E. 6000 ft., January ; and 7000 ft., February.
Distrib. Nile Land and German East Africa.

Striga hermonthica, *Benth. in Hook. Comp. Bot. Mag.* i. (1835) 365.
S.E. 3500 ft. May.
Distrib. Nile Land, Congo Free State, South-west Africa. Also in Egypt and Arabia.

Sopubia ramosa, *Hochst. in Flora*, xxxvii. (1844) 27.
S.W. 3500 ft. July.
Distrib. A common plant in tropical Africa.

OROBANCHEÆ.

OROBANCHE MINOR, *Sutt. in Trans. Linn. Soc.* iv. (1798) 179.

E. 7000 ft. February.

Distrib. East tropical Africa. Also in Europe and Mediterranean region.

GESNERACEÆ.

STREPTOCARPUS RUWENZORIENSIS, *Baker, in Dyer, Fl. Trop. Afr.* iv. Sect. 2, 510.

6000 ft. January.

Distrib. Ruwenzori neighbourhood and Usambara.

BIGNONIACEÆ.

SPATHODEA CAMPANULATA, *Beauv. Fl. Owar.* i. 47.

S.E. 3500 ft. May.

The true plant and not *S. nilotica*, Seem. The present is the most easterly recorded habitat of this Upper and Lower Guinea and Congo Free State species.

ACANTHACEÆ.

THUNBERGIA FASCICULATA, *Lindau, in Engl. Bot. Jahrb.* xvii. (1893) 97.

Semliki Forest. 3000 ft. August.

A Cameroons plant. Differs from the type in the narrower involucral leaves (5·5 × 2·3 cm.), the shorter pedicels (0·7 cm.), the narrower bracteoles (2·0 × 1·4 cm.) pilose-puberulous on both sides, the corolla-tube with a broader throat (1·8 cm. diam.) and the large filaments (about 1·0 cm. long). But the species is such a remarkable one and so different from all the rest, that I am of opinion these differences will not be deemed essential when a full series of specimens comes to hand.

THUNBERGIA (§ Euthunbergia) OCULATA, sp. nov.

Scandens, caule gracili secus lineas duas prope nodos puberulo ceteroquin glabro, foliis longipetiolatis cordatis apice cuspidato acuminatis margine dentato-lobulatis basi palmatim 7-nervibus tenuiter membranaceis utrobique scabriusculis, floribus in axillis solitariis pedunculis elongatis piloso-puberulis fultis, bracteolis majusculis ovato-oblongis obtuse acutis basi late truncatis utrinque scabriusculis margine hispidule ciliatis, calycis dentibus inter se inæqualibus linearibus vel lineari-setaceis pubescentibus, corollæ mediocris tubo basi attenuato superne infundibuliformi limbi lobis inter se subæqualibus rotundato-obcordatis, filamentis brevibus latis antheris late oblongis apice obtuse acutis loculis secus suturam piloso-villosis basi villosis stam. duorum ambobus basi curvato-calcaratis duorum loculo unico solummodo calcarato, ovario late ovoideo

apice obtuso glabro, stylo brevi, stigmate bilabiato labiis firmis inter se inæqualibus (postico paullo longiore) rotundatis, capsula ——.

Hab. Ruwenzori. 6000 ft. January.

Foliorum limbus 6·5–8·0 × 4·5–5·5 cm., fac. inf. pallidior, costulis arctissime reticulatis, glandulis pellucidis microscopicis creberrime indutus, petioli 5·0–8·0 cm. long., sæpe angustissime alati. Pedunculi 8·0–12·0 cm. long. Bracteolæ 2·8–3·0 cm. long., eleganter reticulatæ. Calyx totus 0·5 cm., dentes 0·18–0·35 cm. long. Corollæ tubus vix 3·0 cm. long., ima basi 0·4 cm. lat., tunc ad 0·3 cm. coarctatus, inde subito ad 0·55 cm. dilatatus, faucibus paullo ultra 1·0 cm. lat.; limbus fere 4·0 cm. diam.; lobi 1·8 cm. long., summum 2·0 cm. lat. Antheræ 0·6 × fere 0·2 cm., harum calcara admodum curvato, vix 0·2 cm. long. Ovarium 0·15 cm. long.; stylus 1·25 cm. long., glaber; stigmatis lobus alter 0·175 cm., alter 0·1 cm. long., 0·12 cm. lat.

This can be told at once from all forms of *T. alata*, Boj., to which it is undoubtedly allied, by the long-stalked, cordate, dentate-lobulate leaves, the very long peduncles and the relatively large bracteoles.

BRILLANTAISIA PATULA, *T. And. in Journ. Linn. Soc., Bot.* vii. (1864) 21.
E. 6000 ft. January.
A Cameroons plant found in the Uganda Protectorate (Toro) in 1906 by Dr. Bagshawe.

B. NYANZARUM, *Burkill, in Dyer, Fl. Trop. Afr.* v. 39.
Semliki Valley. July.
Hitherto known only from Kavirondo, Uganda.

MIMULOPSIS ELLIOTII, *C. B. Clarke, in Dyer, Fl. Trop. Afr.* v. 56.
E. 10,000 ft. February.
So far as known, restricted to the neighbourhood of Ruwenzori.

RUELLIA PATULA, *Jacq. Misc. Bot.* ii. 358.
S.E. 3500 ft. June.
Distrib. East and West tropical Africa.

MELLERA LOBULATA, *S. Moore, in Journ. Bot.* xvii. (1879) 225.
S.E. 3500 ft. June.
Distrib. Uganda Protectorate and Mozambique District.

ACANTHOPALE CONFERTIFLORA, *C. B. Clarke, in Dyer, Fl. Trop. Afr.* v. 64.
E. 7000 ft. January.
Distrib. Ruwenzori District and Nyasaland.

BARLERIA GRANTII, *Oliver, in Trans. Linn. Soc.* xxix. (1875) 127.
S.E. 3500 feet. May.
Distrib. Southern Nile Land.

CROSSANDRA GUINEENSIS, *Nees, in DC. Prod.* xi. 281.
Without locality.
Distrib. A West African plant recently found by Dr. Bagshawe in the Uganda Protectorate.

JUSTICIA PINGUIOR, *C. B. Clarke, in Dyer, Fl. Trop. Afr.* v. 197.
E. 9000 ft. January.
Smaller in leaf and much less hairy than the type, otherwise similar to it.
Distrib. British East Africa.

ISOGLOSSA RUNSSORICA, *Lindau, in Engl. Bot. Jahrb.* xx. (1895) 56.
E. 6000 ft. January.
Restricted to the neighbourhood of Ruwenzori.

ADHATODA ENGLERIANA, *C. B. Clarke, in Dyer, Fl. Trop. Afr.* v. 222.
S.E. 3500 ft. June.
Distrib. German East Africa, Uganda (*Bagshawe*).

DICLIPTERA MACULATA, *Nees, in DC. Prod.* xi. 485.
E. 9000 ft. January.
Distrib. Abyssinia; reported recently from Rhodesia.

HYPOESTES TRIFLORA, *Roem. & Schult. Syst.* i. 141.
E. 9000 ft. January.
Distrib. Nile Land and Upper Guinea. Also in India.

H. VERTICILLARIS, *R. Br. Prod.* 474.
E. 7000 ft. January.
Distrib. Common in most parts of tropical Africa.

LABIATÆ.

PLATYSTOMA AFRICANUM, *Beauv. Fl. Owar.* ii. 61.
E. 6000 ft. January.
Distrib. Nile Land, Mozambique District, Upper and Lower Guinea. Also in India.

MOSCHOSMA MULTIFLORUM, *Benth. in DC. Prod.* xii. 49.
7000 ft. January.
Distrib. Abyssinia and Usambara.

HOSLUNDIA OPPOSITA, *Vahl, Enum. Plant.* i. 212.
S.E. 3500 ft. June.

A somewhat remarkable form of this common African and Malagasy species. With large leaves 12–13 × 4·5–5 cm., on petioles nearly 2 cm. long.

PLECTRANTHUS SCHIMPERI, *Vatke, in Linnæa*, xxxvii. (1871–73) 317.
E. 7000? ft. (the first figure indistinct). January.
Distrib. Abyssinia.

PLECTRANTHUS (§ Germania) WOLLASTONI, sp. nov.

Herbaceus, caule erecto tetragono patule hirsutulo, foliis submediocribus petiolatis ample cordatis apice obtuse acutis margine subtiliter crenatis membranaceis utrinque sed præsertim pag. inf. sparsim piloso-pubescentibus in sicco brunnescentibus petiolis quam limbus triplo brevioribus hirsutis, verticillastris sæpissime 6–8-floris (summis 3–5-floris) subumbellatis in spicastris bracteatis paniculatim ramosis hirsutulis ordinatis, bracteis persistentibus ovatis obtusis inferioribus crenulatis superioribus integris sparsim piloso-pubescentibus, pedicellis calyces excedentibus gracilibus pubescentibus, calycis florescentis parvi hirsutuli tubo campanulato lobos paullulum excedente lobo postico ovato-oblongo obtuse acuto lobis reliquis triangularibus breviter acuminatis a postico leviter superatis, calycis fructescentis bene aucti decurvi pilosuli aliquantulum decoloris tubo anguste campanulato perspicue nervoso lobo postico deltoideo obtuso anticis quam laterales paullo longioribus necnon longius acuminatis, corollæ parvæ extus puberulæ tubo calycem florescentem 2plo excedente paullulum supra basin inflexo inde gradatim dilatato, labio postico ovato-quadrato apice emarginato quam anticum obovatum apice integrum parum breviore, genitalibus breviter ex tubo eminentibus, stylo bifido.

Hab. Ruwenzori E. 7000 ft. January.

Folia solemniter 4·5–5·0 cm. long., basi 4·0–4·5 cm. lat., juniora exstant minora (e. g. 2·0–2·5 cm. long.), in bracteas spicastri transeuntia, glandulis microscopicis fuscis inspersa; petioli summum 1·5 cm. long. Spicastra usque ad 20·0 × 14·0 cm. Bracteæ ±0·5 cm. long. Pedicelli 0·5–0·7 cm. long. Flores flavi. Calyx florescens totus 0·25 cm. long.; lobus posticus 0·13 cm., reliqui circa 0·1 cm. Calyx fructescens 0·7 cm. long.; tubus 0·5 cm. long., juxta basin 0·25 cm., ore 0·45 cm. lat.; lobus posticus 0·2 × 0·3 cm.; lobi laterales 0·15 cm., antici 0·175 cm. long. Corolla tota 0·85 cm. long.; tubus 0·5 cm. long.; labium posticum 0·3 × 0·275 cm., anticum 0·35 × 0·3 cm. Genitalia adusque 0·2 cm. corollæ tubum excedentia.

Near *P. albus*, Gürke, which it fairly well resembles in leaf; but the verticillasters have more flowers and the teeth of the calyx are more sharply pointed, while the small yellow corollas are quite different.

Coleus (§ Solenostemonoides) gracilentus, sp. nov.

C. caule erecto tetragono minute pubescente dein puberulo, foliis parvis brevipetiolatis summis subsessilibus ovatis apice obtusis basi truncato-rotundatis leviterve cordatis margine breviter crebroque crenatis tenuiter membranaceis supra puberulis subtus præcipue in nervis minute pubescentibus, floribus parvulis in spicastris racemosis terminalibus vel ex axillis summis oriundis minute pubescentibus digestis, verticillastris stricte umbellatis circa 8-(junioribus vero paucius-)floris, bracteis parvulis ovato-oblongis vel lanceolato-ovatis diuscule persistentibus, pedicellis tenuibus calycem bene excedentibus, calycis florescentis parvuli minute pubescentis tubo campanulato limbum paullulum excedente lobo postico ovato-oblongo obtuse acuto quam laterales lineari-lanceolati acuti paullo longiore lobis anticis inter se liberis lineari-lanceolatis acuminatis antico æquilongis, calycis fructescentis aucti decurvi tubo late cylindrico basi obliquo lobo postico ovato reliquis inter se subæqualibus æquilongo lobis anticis paullo recurvis, corollæ parvæ tubo calycem excedente infra medium curvato a basi gradatim ampliato labio postico late obovato inæqualiter 4-lobo quam anticum cymbiforme apice integrum paullo breviore, genitalibus labium anticum fere æquantibus.

Hab. Ruwenzori E. 6000 ft. January.

Folia 2·0–3·5 cm. long., juxta basin 2·0–2·5 cm. lat., in sicco brunnescentia, pag. inf. glandulis sessilibus rubris creberrime induta; petioli summum 0·5 cm. long., minute pubescentes. Inflorescentia 10·0–25·0 cm. long. Bracteæ ±0·15 cm. long., haud coloratæ. Pedicelli circa 0·4 cm. long. Flores purpurei. Calyx florescens 0·225 cm. long. Calyx fructescens totus circa 0·45 cm. long.; tubus 0·25 cm., lobi 0·2 cm. long.; lobus posticus 0·2 cm. lat. Corollæ tubus 0·3 cm. long., basi 0·1 cm., faucibus 0·25 cm. lat.; labium posticum 0·25 cm. long., hujus lobi laterales admodum abbreviati, terminales rotundati, 0·1 cm. long.; labium anticum 0·35 cm. long.

On superficial examination this might pass for *C. latifolius*, Hochst., a species with, *inter alia*, more deeply and distantly crenate leaves, verticillasters not strictly umbellate and the two front lobes of the calyx connate some way up.

Coleus (§ Solenostemonoides) latidens, sp. nov.

Herbaceus, caule erecto tetragono subsimplici piloso-pubescente, foliis manifeste petiolatis ovatis apice breviter acuminatis basi late truncatis cordatisve tenuiter membranaceis margine mediocriter crenato-serratis sub apice integris pag. sup. pilosulis pag. inf. sparsim piloso-pubescentibus, floribus majusculis in spicastris terminalibus folia multoties excedentibus digestis, verticillastris pluribus sæpissime 12–16-floris subumbellatis pauciramosis inferioribus subdistantibus superioribus haud

aggregatis, bracteis perspicuis ovatis sursum longe acuminatis basi truncatis margine integris vel leviter crenulatis caducissimis haud coloratis, pedicellis calyces multo excedentibus, calycis inferne pubescentis lobo postico ovato-rotundato obtuso quam laterales late oblongi apice truncati plane longiore lobis anticis postico circa æquilongis anguste oblongis acutis ultra medium connatis, calyce fructescente vix aucto decurvo, corollæ tubo calycem excedente sursum gradatim amplificato juxta medium incurvo labio postico abbreviato late obovato breviter 4-lobo antico elongato cymbiformi.

Hab. Ruwenzori E. 9000 ft. February.

Stirps minimum bispithamea. Internodia 2·0–4·0 cm. long. Foliorum limbus solemniter 5·0–7·0 × 3·5–5·5 cm., glandulis microscopicis fuscescentibus præditus ; petioli 0·6–2·5 cm. long. Spicastra 18·0–20·0 cm. long. Verticillastri inferiores intersunt 2·5–3·0 cm., superiores circa 1·0–2·0 cm. Pedicelli gracillimi, minute pubescentes, ±1·0 cm. long. Bracteæ 1·0–1·2 cm. long., basi 0·7 cm. lat. Flores purpurei. Calycis tubus 0·2 cm. long. ; lobus posticus 0·3 cm. long. ; lobi laterales 0·1 cm. long. et lat., antici 0·325 cm. long., lobi omnes ut tubus glandulis parvis inspersi. Corollæ extus puberulæ tubus 0·5 cm. long., basi 0·15 cm., faucibus 0·4 cm. lat. ; labium posticum 0·45 × 0·5 cm., anticum 1·25 cm. long.

Distinguished from its allies (*C. Garckeanus*, Vatke, &c.) by the leaves with their truncate bases and smallish serrations, the acuminate bracts, and among other features the broad truncate lateral lobes of the calyx.

COLEUS (§ Solenostemonoides) CLIVICOLA, sp. nov.

Herbaceus, caule erecto verisimiliter simplici tetragono bene folioso piloso-pubescente tandem puberulo, foliis sessilibus oblongo-ovatis sursum gradatim attenuatis apice obtusis basi latis et aliquantulum obliquis et breviter amplexicaulibus margine subtiliter crenulato-serratis membranaceis supra fere glabris subtus in costa media costisque secundi ordinis piloso-pubescentibus, spicastris terminalibus folia multo excedentibus fulvo-hirsutulis, verticillastris pluribus stricte umbellatis racemum referentibus circa 8-floris inferioribus subdistantibus, bracteis parvis ovatis obtusis caducissimis haud coloratis, floribus majusculis breviter pedicellatis, calycis pedicellos leviter superantis pubescentis statu fructifero parum aucti necnon decurvi lobo postico ovato-oblongo acuto quam reliqui lineari-lanceolati paullo longiore, lobis lateralibus acutis quam antici acuminati inter se liberi paullulum brevioribus, corollæ tubo calycem excedente juxta basin curvato inde dilatato labio postico 4-lobo quam anticum magnum cymbiformi plane breviore.

Hab. Ruwenzori E. 10,000 ft. February.

Planta saltem bispithamea. Internodia 3·0–5·0 cm. long. Folia sæpissime

4·0–6·0 × 2·0–2·5 cm., serraturis summum 0·15 cm. altis, in sicco olivaceo-castanea, pag. inf. glandulis sessilibus perspicuis rubescentibus copiose instructa. Spicastrum rite evolutum 20·0 cm. vel ultra. Verticillastri inferiores intersunt 3·0 cm., superiores 1·0–2·0 cm. Pedicelli hirsutuli, 0·3 cm. long. Flores purpurei. Calyx florescens glandulis rubescentibus onustus; hujus tubus 0·2 cm., lobus posticus 0·3 cm., lobi laterales vix 0·2 cm., antici 0·225 cm. long. Calycis fructescentis tubus 0·25 cm. long.; lobus posticus ovatus, 0·35 cm. long.; lobi laterales 0·22 cm., antici 0·3 cm. long. Corollæ tubus 0·6 cm. long., ima basi 0·2 cm. faucibus 0·5 cm. lat.; labium posticum 0·5 cm., anticum 1·1 cm. long., hoc juxta apicem pubescens.

Near *C. edulis*, Vatke, and *C. aquaticus*, Gürke; distinguished from both by the small leaves with nerves hairy on the underside and finely-toothed margin, the short pedicels, the small upper lip, &c.

PYCNOSTACHYS ELLIOTII, sp. nov.

Fruticosa, elata, ramulis validis tetragonis longitrorsum striatis pubescentibus subinde glabrescentibus, foliis amplis ovatis sæpe breviter cuspidatis apice obtusis basi truncato-rotundatis ipsa obtusis margine subtiliter necnon creberrime crenato-serratis juxta basin integris tenuiter membranaceis utrobique sparsim pubescentibus, spica sat longe pedunculata cylindrica ipsa quam folia breviore, bracteis basalibus calyces subæquantibus lineari-lanceolatis acutis puberulis, calycis tubo a lamellis interpositis omnino occluso anguste campanulato puberulo, lobis tubum plus quam duplo excedentibus lineari-subulatis apicem versus incrassatis induratisque apice acuminatis albide hispidulis, corollæ pro rata magnæ recurvæ extus glandulis rubescentibus inspersæ tubo paullo supra basin contracto ibique inflexo superne gradatim dilatato labio postico subquadrato lobis inter se subæqualibus triangularibus obtusis labio antico elongato cymbiformi apice integro, genitalibus longe exsertis.—*P. urticæfolia*, Baker, in Dyer, Fl. Trop. Afr. v. 386 *ex parte*, non Hook.

Hab. Ruwenzori. 9000 ft. (Also Ruwenzori; Scott Elliot, 7719.)

Frutex adusque circa 6-metralis ("15–20 ft."). Foliorum limbus profecto evolutus 9·0–10·0 × 6·0 cm., in sicco brunnescens, utrinque glandulis microscopicis perlucentibus præditus; serraturæ 0·15 cm. alt., 0·1–0·2 cm. lat.; petioli 2·0–3·5 cm. long., pubescentes. Pedunculus validus, 4·0–7·0 cm. long. Spica (corollis haud exemptis) 6·0–7·0 × 3·0 cm. Bracteæ 0·5 cm. long. Flores albi. Calycis florescentis tubus vix 0·2 cm. long.; hujus lobi circa 0·5 cm. long. (pars incrassata 0·2 cm.); lamellæ interpositæ ovato-rotundatæ, 0·1 cm. long. Corollæ tubi pars basalis comparate amplificata 0·2 × 0·175 cm.; pars constricta 0·15 × 0·05 cm.; pars dilatata 0·8 cm. long., faucibus 0·5 cm. diam. Labium posticum 0·25 cm. long.; hujus lobi 0·075 cm. Labium

anticum 0·8 cm. long. Genitalia usque ad 1·1 cm. e tubo corollæ eminentia.

A very distinct plant, known by the ample petiolate broad-based leaves with numerous small serrations, the broad spikes, the calyx-lobes indurated only at the top, the long white corollas, &c.

MICROMERIA BIFLORA, *Benth. in DC. Prod.* xii. 220.

E. 7000 ft. February.

Distrib. Nile Land, Mozambique, Upper and Lower Guinea; also S. Africa, India.

STACHYS ACULEOLATA, *Hook. fil. in Journ. Linn. Soc., Bot.* vi. (1862) 18.

E. 8000 and 11,000 ft. February.

The higher-level specimens are without prickles.

Distrib. Abyssinia to Cameroons.

CALAMINTHA (§ Acinos) PARVULA, sp. nov.

Herbacea, caule gracili humili deorsum repente necnon radicante sursum ascendente piloso-hirsutulo deinde puberulo, foliis sparsis parvulis petiolatis rotundato-ovatis obtusis basi rotundatis obtusisve nequaquam cordatis margine serrato-crenatis planis utrinque pilis paucis strigosis appressis albis munitis fac. sup. in sicco nigricantibus, verticillastris sæpissime 4–7-floris ex foliorum superiorum axillis oriundis, bracteolis abbreviatis angustissime linearibus pilosis, pedicellis gracilibus quam calyx brevioribus piloso-hirsutis, calycis tubo piloso-hispidulo deorsum inflato quam limbus longiore intus pilorum annulo instructo labio postico rotundato lobis abbreviatis subulatis labii antici lobis triangularibus acuminatis lobis omnibus margine longe ciliatis, corollæ tubo ex calyce breviter eminente sursum leviter amplificato labio postico quam anticum breviore apice truncato integro antici lobis rotundatis intermedio latiore emarginato, staminibus anticis subinclusis posticis imminutis cassis, styli lobis admodum inæqualibus,

Hab. Ruwenzori E. 11,000 ft. February.

Folia solemniter 0·7 × 0·6 cm., firme membranacea, subtus in sicco griseo-viridia; petioli 0·3–0·4 cm. long., piloso-hirsutuli. Bracteolæ circa 0·2 cm., pedicelli 0·3 cm. long. Calyx totus 0·6 cm.; tubus 0·4 cm., basi faucibusque 0·22 cm. lat., medio 0·18 cm.; labium anticum 0·2 cm. long., hujus lobi 0·15 cm. long.; posticum 0·2 cm. long., lobi 0·06 cm.; pilorum annulus ad 0·1 cm. infra os insertus. Corolla 0·7 cm. long.; tubus extus superne pubescens, basi 0·1 cm. faucibus 0·2 cm. lat.; labium posticum 0·15 cm., anticum 0·3 cm. long. Stylus 5·5 cm. long.; stigmatis lobus alter debilis 0·025 cm., alter incurvus 0·1 cm. long.

To be placed next *C. simensis*, Benth., from which it can be distinguished

by the rather coarsely crenate-serrate leaves drying black, the longer lobes of the calyx (which organ has a ring of weak hairs inside inserted a little distance from the mouth instead of one with many coarse hairs inserted in the mouth itself), and the reduced posticous pair of stamens.

PLANTAGINEÆ.

PLANTAGO PALMATA, *Hook. fil. in Journ. Linn. Soc., Bot.* vi. (1862) 19.
E. 7000 ft. January.
Distrib. Mountains from Cameroons to Kilimanjaro.

APETALÆ.

By A. B. RENDLE.

The collection includes the following well-known plants:—*Pircunia abyssinica*, Moq., E. 7000 ft. (tropical and South Africa and Madagascar); *Chenopodium fœtidum*, Schrad., E. 7000 ft. (generally distributed in the tropics and warm temperate zones); *Basella alba*, Linn., E. 7000 ft. (tropical Africa and Asia); *Amaranthus caudatus*, Linn., S.E. 3500 ft. (warmer parts of the Eastern hemisphere); *Achyranthes aspera*, Linn., E. 6000 & 7000 ft. (tropics of Old World); *Celosia trigyna*, Linn., S.E. 3500 ft. (common in tropical and South Africa); *Euphorbia hypericifolia*, Linn., S.E. 3500 ft. (a common weed in the warmer parts of the earth); in addition to the following.

AMARANTACEÆ.

CYATHULA CYLINDRICA, *Moq. in DC. Prodr.* xiii. 2. 328.
E. 6000 ft. January.
Distrib. Tropical and South Africa and Madagascar.

POLYGONACEÆ.

RUMEX ABYSSINICUS, *Jacq. Hort. Vindob.* iii. 48.
E. 7000 ft. January.
Distrib. Highlands of East tropical Africa and Madagascar.

R. STEUDELII, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 229.
E. 7000 ft. January.
Distrib. East tropical Africa and Cameroons.

PIPERACEÆ.

PIPER CAPENSE, *Linn. f. Suppl.* 90.

E. 7000 ft. January.—Also collected by Scott Elliot (No. 7909) in the Wimi valley at 7000–8000 ft.

Distrib. East tropical Africa, Cameroons, South Africa.

PEPEROMIA RUWENZORIENSIS, sp. n.

Herba, caulibus junioribus et petiolis pilosulis; foliis alternis lanceolatis vel ovatis, apice acutis, siccis tenuibus, in dorso laminæ sparse pilosis, 3-nerviis; amentis modice pedunculatis, in axillis foliorum superiorum et terminalibus folia valde excedentibus; bractea orbiculare; ovario rhachi impresso, late obovato, apice obtuso, stigmatifero; bacca minima, late ovata, brunnea, glandulosa.

Hab. Ruwenzori E. 7000 ft. January. Climbing; flowers greenish white.—Also collected by Scott Elliot at 7000–8000 ft., on tree-trunks. In fruit, May. No. 7862 in part.

Caulis 2 mm. crass. e nodis in arborum truncis radicans. Folia cum petiolo vix 1 cm. long., ad 5 cm. long. et 3 cm. lat., sæpissime minora. Amenta ad 5 cm. long., 1·5 mm. crass. Bacca 1 mm. long.

Near *P. Stuhlmanni*, which was collected about the same altitude on Ruwenzori by Stuhlmann, and differs in being a glabrous plant with leaves oblong-lanceolate and acute at base and apex. I have to thank Dr. Engler for comparing our specimens with the type of *P. Stuhlmanni* at Berlin.

URTICACEÆ.

PARIETARIA DEBILIS, *Forst. f. Prodr.* 387.

E. 12,000 ft. February.

Distrib. Widely spread in temperate and tropical regions, and occurring in Africa in Abyssinia and the Cameroons.

FLEURYA PODOCARPA, *Wedd. in DC. Prodr.* xvi. 1. 76.

E. 5000 ft. March.

Distrib. East and West tropical Africa.

EUPHORBIACEÆ.

TRAGIA CORDIFOLIA, *Benth. in Hook. Niger Flora*, 501.

E. 7000 ft. January (fruit).

Distrib. East and West tropical Africa, and found on Mts. Kenia and Kilimanjaro.

ACALYPHA PSILOSTACHYA, *Hochst. ex A. Rich. Tent. Fl. Abyss.* ii. 246.

E. 7000 ft. January.

Distrib. East tropical Africa.

Fig. 1.

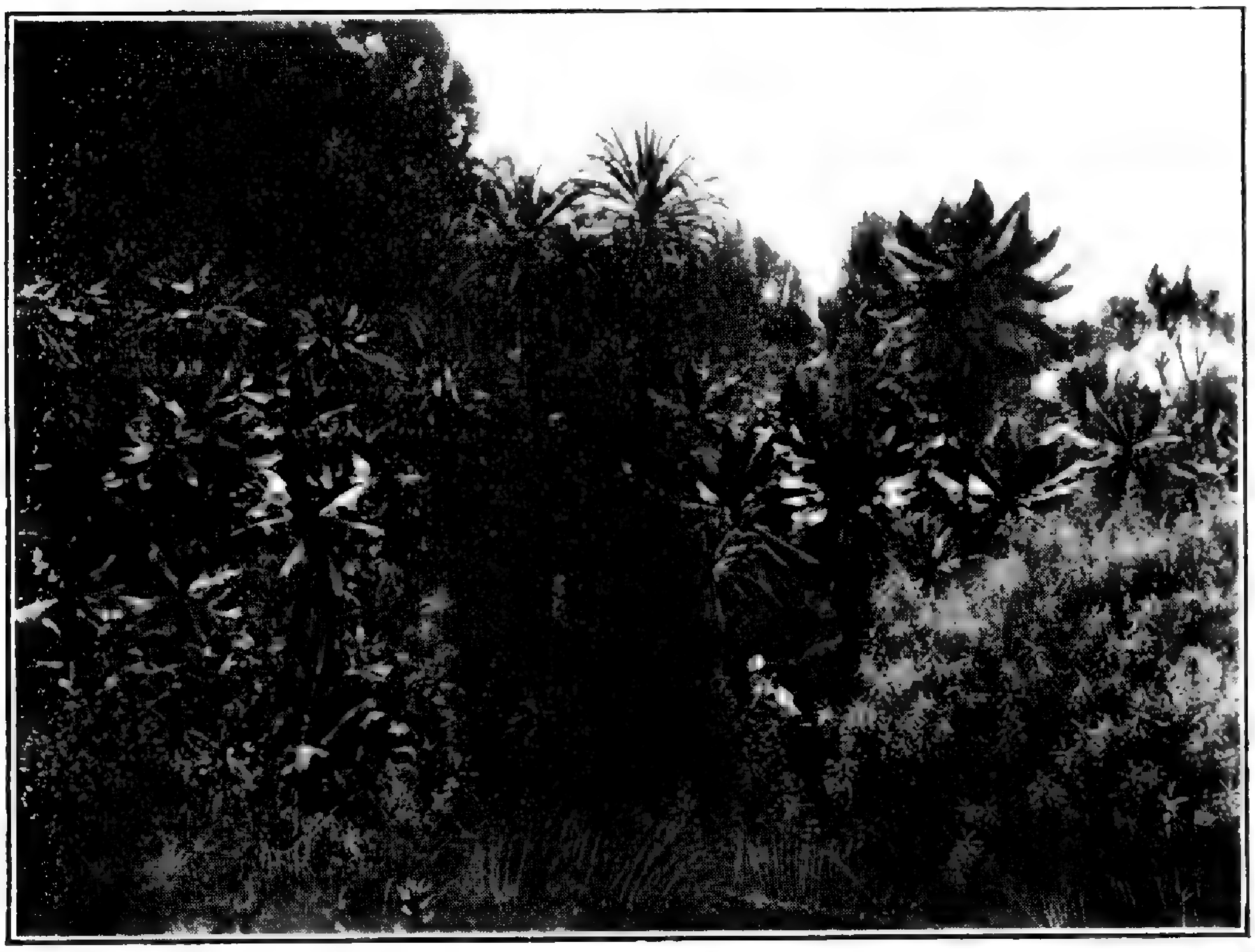


Fig. 2.

VEGETATION ON MOUNT RUWENZORI

FIG. 3.

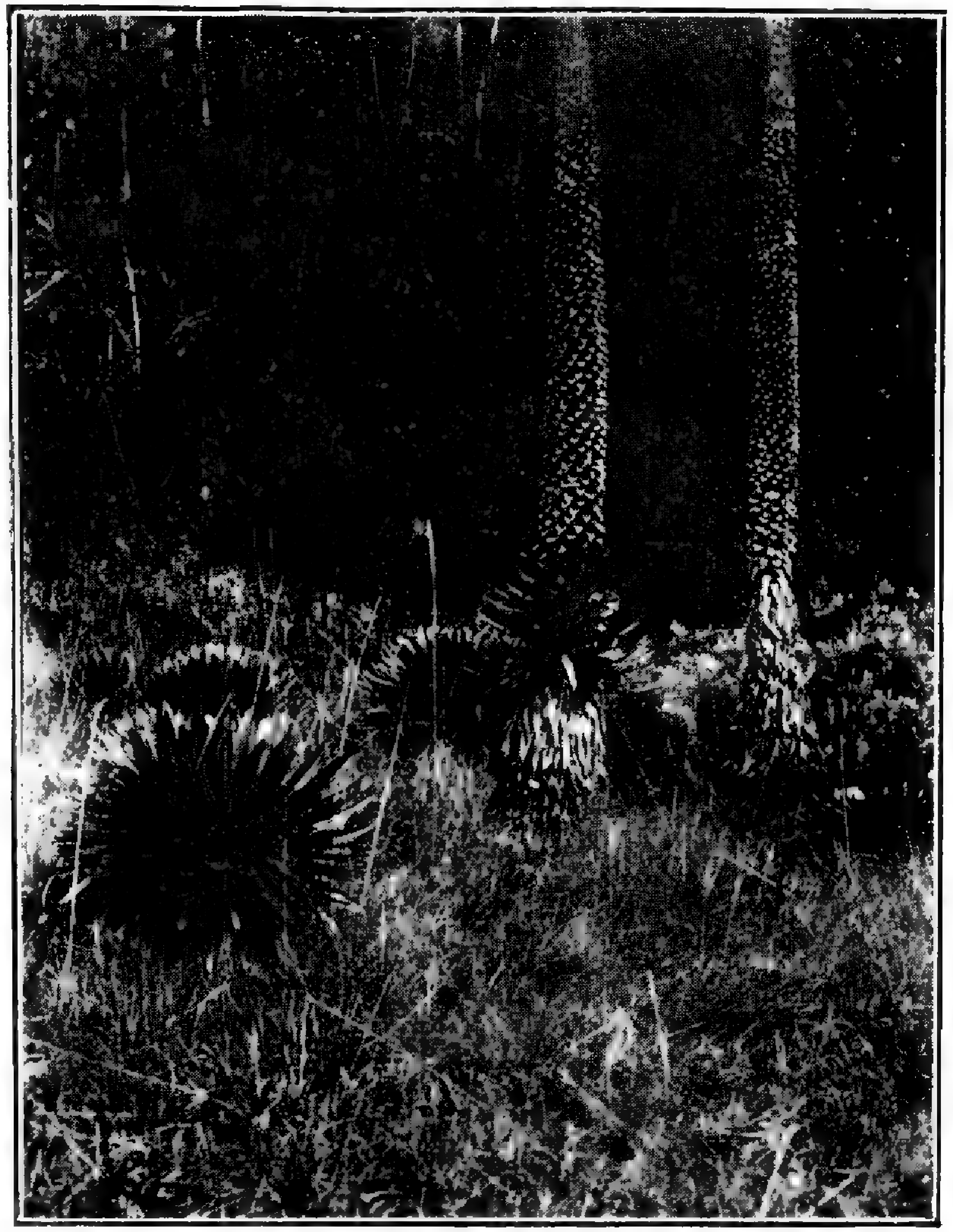


FIG. 4.

VEGETATION ON MOUNT RUWENZORI.

FIG. 5.

FIG. 6.

VEGETATION ON MOUNT RUWENZORI.

FIG. 7.

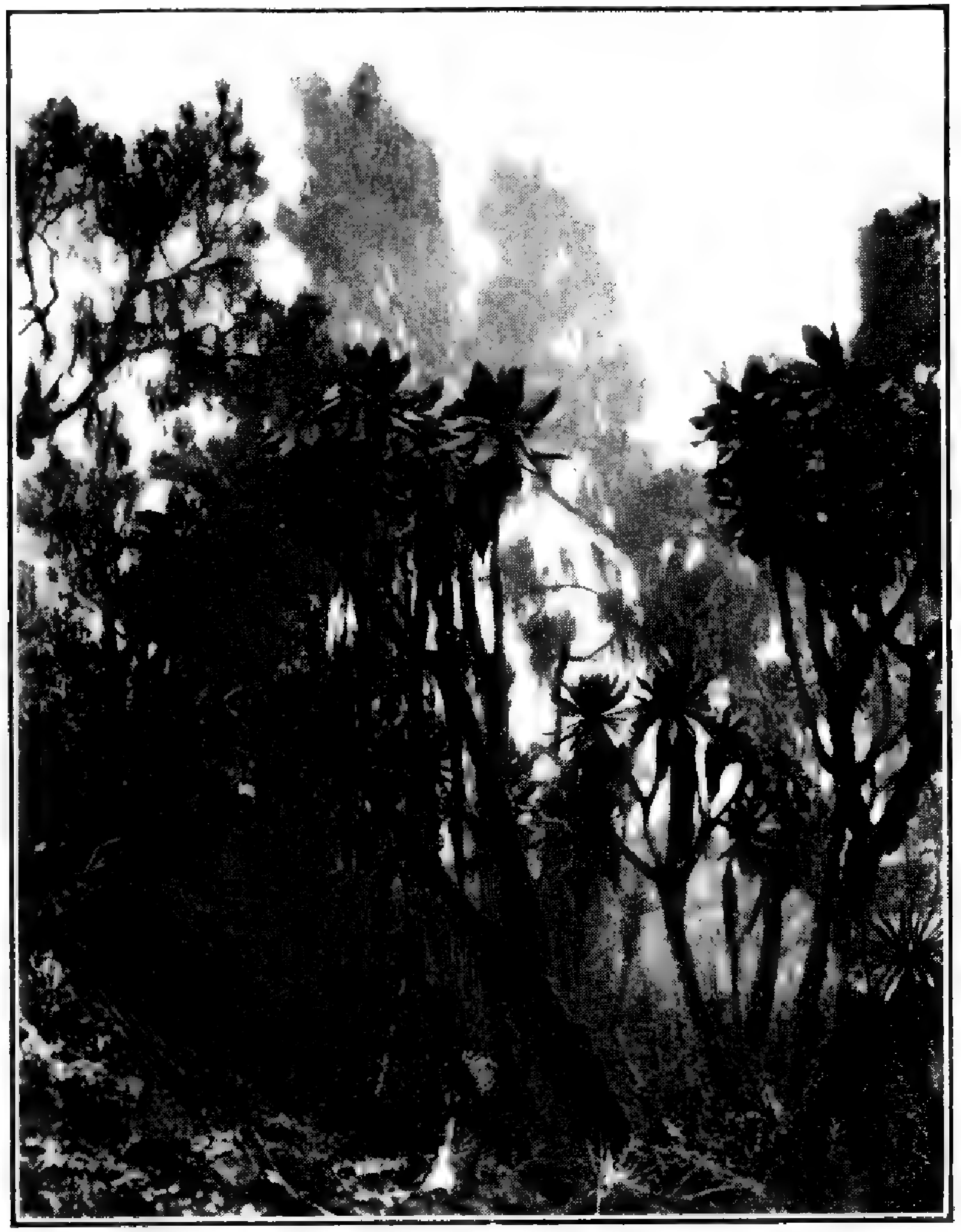


FIG. 8.

VEGETATION ON MOUNT RUWENZORI.

EXPLANATION OF THE PLATES.

(From Photographs taken by Dr. A. F. R. Wollaston.)

Plate 16.

Fig. 1. Vegetation on Mt. Ruwenzori at 3500 feet, with *Euphorbia*, *Acacia*, and short grass.

2. Tree Senecios, with *Lobelia Stuhlmanni* in the centre, at 9500 feet.

Plate 17.

Fig. 3. *Lobelia Gibberoa* at 7000 feet.

4. *L. Deckenii* in flat swampy ground at 11,000 ft.

Plate 18.

Fig. 5. *Senecio adnivalis* to the right showing branching, Lobelias to the left, *Lobelia Wollastoni* in front, at 12,000 ft.

6. Steep slope with tree Senecios, probably *Senecio adnivalis* and *Lobelia Wollastoni*, at 13,000 ft.

Plate 19.

Fig. 7. *Lobelia Wollastoni* at 12,500 to 13,000 feet. The Kyanga Peak is seen in the background.

8. Very old tree Senecios at 12,500 feet: tree heath, *Erica arborea*, in the background.

Some Critical Green Algæ. By G. S. West, M.A., A.R.C.S., F.L.S., Lecturer on Botany at the University of Birmingham.

(Plates 20 & 21.)

[Read 20th June, 1907.]

During the examination of numerous collections of Algæ, I have repeatedly brought before my notice many forms about which little or nothing is known, and a brief account of the peculiarities and affinities of some of these may prove of considerable interest. The six Algæ dealt with in this paper are all members of the Chlorophyceæ.

1. Polychætophora simplex, sp. n. *P.* cellulis subglobosis vel ovoideis, membrana tenue et homogenea; parte dorsali cellulæ uniuscujusque setis longis flexuosis simplicibus non vaginatis 2–4 instructa; chromatophoris singulis parietalibus, interdum cum granulis amylaceis minutis circ. 2–3. Diam. cell. veget. 15–20 μ; long. set. usque ad 210 μ. (Pl. 20. figs. 1–6.)

Hab. Shores of Lough Gartan, Donegal, Ireland; epiphytic on the submerged portions of various aquatic phanerogams.

The discovery of this Alga adds a second species to a genus which has so far been known only by the solitary species *Polychætophora lamellosa*, W. & G. S. West[1].

The specimens were collected in 1901 on the shores of Lough Gartan, Donegal, and occurred as epiphytes on various aquatic flowering plants.

The cells are globose or ovoid in form, rather small, and destitute of any appreciable mucous envelope. They are solitary, or occur two or three together, having but a slight attachment to the plant upon which they grow. There is a distinct dorsiventrality about the cells, although there is no attempt at the formation of either a creeping filament or a flat plate. The ventral part of the cell is attached to the substratum, and the other part, which may be regarded as dorsal, is furnished with from two to four simple, but greatly elongated bristles. There is one parietal chloroplast in each cell, normally somewhat cup-shaped and occupying the ventral wall. No pyrenoids were observed, but several scattered granules of minute size, which stained blue-black with chlor-zinc-iodine, were observed in some of the cells. These were most probably small granules of starch (fig. 6). A small nucleus is present towards one side of the hollow in the cup-shaped chloroplast (fig. 6, *n*).

Polychætophora simplex differs from *P. lamellosa* in the smaller size of its cells, in the very much thinner cell-wall, which is not lamellose, and in the restricted number of bristles. From eight to twelve of the latter are present in *P. lamellosa*, and they are distributed all round the exterior of the cell, whereas there are only two to four bristles in *P. simplex*, and their dorsal attachment is a conspicuous feature of the species.

The genus *Polychætophora* belongs to the Chætopeltideæ, a small family distinguished from the rest of the Protococcoideæ by the presence of setæ or bristles.

Nothing is known of the reproduction of *Polychætophora*, but in *P. lamellosa* multiplication takes place by the division of the cells in one plane and the formation of a short irregular chain. This short filament, consisting of about eight cells, subsequently breaks up, each cell being able under suitable conditions to form a new chain.

It is possible that *Polychætophora simplex*, or a closely allied Alga, is responsible for the confusion which has existed concerning the identity of *Glæochæte Wittrockiana*. The latter was described by Lagerheim[2] from Sweden as a blue-green Alga, and I have since found it repeatedly. There is not the slightest question that it is one of the Myxophyceæ[3] of the subfamily Chroococcysteæ, with a cytological structure closely akin to that of *Chroococcus*. Yet

[1] W. & G. S. West, "Notes on Freshwater Algæ.—III.," Journ. Bot. xli. (1903) p. 79, t. 448. figs. 1–4.

[2] G. Lagerheim, "Bidrag till Sver. Algafl.," Öfvers. K. Sv. Vet.-Akad. Förh. (1883), no. 2, p. 39, t. 1. ff. 3–4; Nuova Notarisia (1890), p. 231.

[3] G. S. West, "Alga-fl. Cambs.," in Journ. Bot. xxxvii. (1899) p. 264.

Dangeard [1], Schmidle [2], and Borge [3] have all placed *Glœochæte Wittrockiana* in the Chlorophyceæ. It therefore seems probable that these authors really had a green Alga under observation, and not the blue-green Alga described by Lagerheim.

Polychætophora simplex and *Glœochæte Wittrockiana* should not be confused. The former is a member of the Chlorophyceæ, and its cells, which are not enveloped in mucilage, are each furnished with two to four simple bristles. The latter is one of the Myxophyceæ, with its cells enveloped in a copious mucilage, and its bristles frequently possess short spur-like branches.

2. BRACHIOMONAS SUBMARINA, *Bohlin.* (Pl. **20.** figs. 7–19.) I am indebted to Mr. Thomas Bolton, of Birmingham, for kindly bringing me, in the early part of February 1907, a tube containing a motile green Alga of great interest. It was collected in brackish marshes at Sheerness by the Rev. Eustace Tozen, who sends the information that it is common there in February. Mr. Bolton was also good enough to procure me a further supply of this Alga in April.

The Alga is a member of the subfamily Chlamydomonadeæ of the Volvocaceæ, and belongs to *Brachiomonas*, Bohlin, a genus which, so far as I am aware, has only been previously observed from the brackish marshes and harbours of Stockholm and certain of the coast districts of Norway. Two species were described by Bohlin [4] ten years ago, but do not appear to have been since recorded.

The plant from Sheerness does not strictly agree with either of the species described by Bohlin, but to a certain extent combines the characters of each of them. The anterior half of the cell is subhemispherical and the posterior half conical. The posterior extremity is provided with a stout attenuated horn, and four other equidistant horns are disposed in the equatorial plane. The equatorial horns are backwardly curved, but otherwise similar to the straight posterior horn.

The parietal chloroplast, which is somewhat massive, does not extend into the horn-like processes, except to form a rounded lobe at the base of each. A large pyrenoid is present [5], usually towards the posterior region, and a number of bright granules are scattered through the chloroplast.

At least one vacuole is present in the cell, and there may be one near the base of each process. A solitary vacuole is usually large, and often of

[1] Dangeard in 'Le Botaniste' (1889), p. 158, t. 7. f. 12 *a–j* (described as a new Alga under the name of *Schrammia barbata*, Dang.).

[2] W. Schmidle, "Beitr. alp. Algenfl." in Oesterr. botan. Zeitschr. xlv. (1895) p. 306, t. 14. f. 9.

[3] O. Borge, "Süsswasseralg. Süd-Patagon." in Bih. K. Sv.Vet.-Akad. Handl. (1901) no. 10, p. 16.

[4] K. Bohlin, "Zur Morphologie und Biologie einzelliger Algen," in Öfvers. K. Vet.-Akad. Förh. (1897) no. 9, pp. 508–510.

[5] Sometimes more than one pyrenoid is present (*vide* fig. 11).

irregular form, being situated in the anterior region of the cell. When more than one vacuole exists, they are commonly spherical. They contain a colourless cell-sap, and in all the specimens examined granules of a brown colour were present, which exhibited a lively dancing movement (figs, 7, 9–11, 18, 19). These granules varied in number from 2 to 15 in each vacuole, and were of various sizes. They strongly reminded one of those formed in the vacuoles of most Desmids under pathological conditions [1].

The nucleus is situated anteriorly, but may be displaced by the formation of a large vacuole.

The horns are colourless and very hyaline, but as the cytoplasm of each process can be stained up to its extremity, they are hollow.

A pair of long cilia are attached to the anterior extremity, and as the organism progresses in a forward direction, it rotates about its longitudinal axis. This rotation is not constant, as the organisms, when examined on a slide, frequently come to rest and then begin again their movements, when, as often as not, they rotate in the opposite direction.

The rate of movement was measured in a number of full-grown vegetative cells, and it gives an average of 0·22 mm. per second, which is considerably below the average for the Chlamydomonadeæ.

When at rest the cilia are carried backwardly directed, with the proximal part of each cilium closely pressed against the anterior margin of the cell (fig. 9).

Several cultures of this organism were started in February and examined constantly up to May. Some were in Knop's solution, and others in Knop's solution to which a small quantity of sodium chloride had been added. The tube of material as forwarded to me was a pure collection, and the most diligent search brought to light no other organism among the *Brachiomonas*. A few drops of this fluid containing the living *Brachiomonas* were added to about 150 c. c. of the prepared medium, so that no trace of colour could be observed in the culture. The glass culture-vessels were exposed to the outside air temperature, except during frost. All the cultures became decidedly green at the beginning of April, but there was a marked difference in the two series. Those cultures from which sodium chloride was excluded contained hardly any *Brachiomonas*, but a species of *Chlamydomonas* and a multitude of rounded green cells in the palmelloid condition [2].

Those containing sodium chloride were pure cultures of *Brachiomonas*, and the multiplication was carried on with moderate rapidity by the formation of zoogonidia. Four of these arose in each mother-cell, and they assumed the peculiar form of the adult before liberation.

[1] Consult G. S. West, in Journ. Linn. Soc., Bot. xxxiv. (1899) pp. 401, 402.

[2] I have been unable to determine with any degree of certainty the species of Alga to which these belong. Most of the Chlamydomonadeæ are known to assume a palmelloid state under certain conditions, but I hesitate to refer the above-mentioned cells to *Brachiomonas*.

During May some of the cells formed gametes, which differed from the zoogonidia in their smaller size and greatly reduced processes (fig. 16). In fact, the latter were only discernible as very minute conical warts. These gametes, which, so far as I could ascertain, arose 16 in a mother-cell, conjugated in pairs and formed globular zygospores with smooth walls.

As is usual in so many cultures of Algæ, some of the individuals were distorted and monstrous. The commonest distortion from the original type was an inflated, swollen individual, in which the body of the cell was spherical, the processes appearing correspondingly small (fig. 18). These individuals only appeared in a three-months' culture. The most interesting monstrous form was an incomplete separation of two individuals, owing to imperfect division of the contents of the mother-cell during the formation of zoogonidia (fig. 19).

After much consideration I have referred the Sheerness organism to *Brachiomonas submarina*.

None of the adult vegetative specimens had the processes quite so short as figured by Bohlin for *B. submarina*, and some of the specimens agree in form with Bohlin's fig. 1 *b* of *B. gracilis*; but the only alternative was to establish a third species intermediate in character between the two already described. This was inadvisable, because in the outward form of the cells, which alone was used in discriminating between *B. submarina* and *B. gracilis*, the Sheerness specimens exhibited much variability. The anterior region of the cell was never so flattened as in Bohlin's figs. 1 *a* and 1 *c* of *B. gracilis*, and the posterior horn rarely so long, whereas the subhemispherical anterior region of the cell and the form of the posterior horn were characters in agreement with *B. submarina*.

Length of Sheerness specimens (including horns) 15–24 μ; breadth (including horns) 13–25 μ; length of cilia 22–29 μ.

If Bohlin's figures are correct, then the Sheerness specimens differed in one respect from both his species. The chloroplast never extended beyond the broad base of the horns, the latter always remaining clear and colourless.

3. PHYLLOBIUM SPHAGNICOLA, sp. n. *Ph.* filis vegetativis longissimis, subcontortis et anastomosibus, inter cellulas foliorum *Sphagni* cretis; cellulis vegetativis elongatis et subcylindricis, membrana tenuissima; hypnosporis globosis vel subdepresso-globosis, membrana firma et crassa, nonnunquam irregulariter incrassata. Crass. fil. veget. 2·7–4 μ; diam. cell. hypnosp. 18–42 μ. (Pl. **21**. figs. 31–35.)

Hab. North Uist, Outer Hebrides; on the old leaves of *Sphagnum*.

In August 1904 my father collected some plants of *Sphagnum* in the boggy areas of N. Uist, Outer Hebrides, which had attracted his attention by reason

of their peculiar appearance. The plants were old, with withered, bleached leaves, on which were dotted here and there irregular blotches of a vivid green colour.

A closer examination of the leaves showed them to be studded with the dark green cells of an epiphytic Alga. Some of the specimens were dried and others were preserved in 2 per cent. formalin, and on further investigation the epiphyte has proved to be an undescribed species of the genus *Phyllobium*.

The two previously known species of this genus, *Phyllobium dimorphum*, Klebs, and *P. incertum*, Klebs [1], were discovered on dead leaves—the former on *Lysimachia Nummularia*, *Ajuga*, *Chlora*, &c., and the latter on the leaves of *Carex*. This is the first recorded instance of a *Phyllobium* occurring on the leaves of *Sphagnum*, and I have named it *Phyllobium sphagnicola*.

The bright green cells studding the exterior of the old *Sphagnum*-leaves are the resting-cells, and occur either scattered or in irregular clusters. The cell-wall is often irregularly thickened, and not infrequently produced out at some indefinite point into a curved beak-like projection (fig. 33). All the thickened parts of the cell-wall show a marked lamellation. These green cells are attached at the base to the vegetative thallus, consisting of slender branched threads, anastomosing and ramifying over the entire leaf. Each resting-cell is attached to one or sometimes two of the vegetative threads, and the wall in the region of attachment is generally much thickened and lamellose. The adult vegetative threads are destitute of protoplasts or of chlorophyll, are much branched, and distinctly but distantly septate. These threads follow a very irregular course, commonly passing through the leaf by means of the perforations in the large hyaline cells.

As the specimens were preserved, the formation of gametes and zoogonidia could not be observed.

The green resting-cells of *Phyllobium sphagnicola* are smaller and more rounded than those of *P. dimorphum*, and their attachment to the vegetative filaments is more basal than lateral. The threads composing the vegetative part of the thallus are also profusely developed, possibly owing to the ease with which they can traverse the large hyaline cells of the *Sphagnum*-leaf.

4. Kirchneriella subsolitaria, sp. n. *K.* cellulis minutis, obesis, arcuatissimis, polis obtusis vel rarissime subacutis, sæpe magnitudinis inæqualis; cellulis plerumque solitariis vel in coloniis parvis e cellulis 2–4 constitutis, coloniis non mucosis. Diam. max. cell. 6–7 μ; crass. cell. 2·9–3·2 μ; crass. colon. 4 cell. 10–15 μ. (Pl. **20.** figs. 20–30.)

Hab. Studley Park, Warwickshire; in small pond.

[1] G. Klebs, "Beiträge zur Kenntnis niederer Algenformen," in Bot. Zeit. xxxix. (1881) pp. 268–272, 281–290, 297–300, 332–333; t. 3. ff. 29–37; t. 4. ff. 38–49, 50–54.

Kirchneriella subsolitaria differs from the three previously known species of the genus in the subsolitary habit and the entire absence of mucus. In the form of its cells it greatly resembles *K. obesa*, but apart from its different habit it is much smaller.

The genus *Kirchneriella* was founded by Schmidle[1] in 1893 to include a small protococcaceous Alga which had been regarded by Kirchner as an *Ankistrodesmus* (=*Rhaphidium*). This plant, *Kirchneriella lunaris*, Schmidle, and another species, *K. obesa*, W. & G. S. West[2], have been shown to be fairly abundant in the European freshwater plankton, the latter being sparingly distributed in the summer plankton of the lakes of Western Scotland[3]. A third species, *K. contorta*, (Schmidle) Bohlin, is known from Germany, and var. *gracillima* of it from South America[4].

The most important generic character, which is well marked in all the three species and several named varieties of them, is the somewhat irregular disposition of a number of arcuate cells within a copious structureless mucilage. As will be seen from the description of the newly discovered species, this generic character will have to be modified for the inclusion within the genus of *K. subsolitaria*.

This undescribed species was found in October 1906, among numerous other Algæ of the Protococcaceæ, in a collection made from a small pond in Studley Park, Warwickshire. The cells agree almost exactly with those of *K. obesa*, but are much smaller. They are stout and much bent, but show a greater irregularity of form than is seen in *K. obesa*. Very often one limb of the cell is much thicker than the other (figs. 21–23), or both limbs may be much attenuated (fig. 20). There is a chloroplast filling up the greater part of the cell, but in some cases not extending quite to the poles. This chloroplast has a homogeneous structure, and is without pyrenoids or any trace of granulation. Most of the cells were solitary, but small colonies of 2 or 4 cells were not uncommon (figs. 26–30). The cells in each colony were enclosed in a thin, firm membrane, globular or ellipsoidal in form, which fitted closely round them. This membrane is the dilated wall of the mother-cell, which, however, does not undergo gelatinization. No colony of more than four cells was observed, and no mucilaginous envelope is present aronnd either the solitary cells or the small colonies. It is this absence of enveloping jelly that necessitates a slight modification in the generic characters of *Kirchneriella* in order to include *K. subsolitaria*.

[1] W. Schmidle in Ber. naturf. Ges. Freib.-i.-Br. Bd. vii. (1893) p. 15, t. 3. ff. 2, 3.

[2] W. West & G. S. West in Journ. Roy. Microscop. Soc. (1894) p. 16; Schmidle in Flora, lxxxviii. (1894) p. 44.

[3] W. West & G. S. West in Journ. Linn. Soc., Bot. xxxv. (1903) p. 531; in Trans. Roy. Soc. Edin. xli. part iii. no. 21 (1905) p. 489.

[4] K. Bohlin, Algen der Erst. Regnell'schen Expedit., Bih. till K. Sv. Vet.-Akad. Handl. Bd. 23. Afd. iii. no. 7, p. 20, t. 1. ff. 25–27.

An Alga has recently been described by Schmidle[1], under the name of *Didymogenes palatina*, which bears much resemblance to *Kirchneriella subsolitaria*. Its cells, which are mostly in pairs, are not bent anything like so much, and each possesses a chloroplast with one *pyrenoid*. I do not see how Schmidle finds any generic characters for *Didymogenes palatina*; but whatever it may be, it is not the Alga here described as *Kirchneriella subsolitaria*.

5. TETRAËDRON PLATYISTHMUM, nob. (= *Cosmarium platyisthmum*, Archer, 1880). *T.* mediocre, subrectangulare, compressum, circiter tam longum quam latum, lateribus late excavatis cum isthmo lato et longo in centro cellulæ, apicibus convexis sed in medio leviter retusis, angulis lateralibus subproductis et incrassulatis, cum fossa inconspicua longitudinaliter disposita in centro cellulæ pæne tenus apice unoquoque; membrana conferte punctulata, cum serie singula punctorum majorum trans partes latiores duas cellulæ. Cellula a vertice visa elliptica, polis attenuatis, excavatione minuta ad medium utrobique; a latere visa elliptica. Chromatophora cum pyrenoide centrali. Long. 24–35 μ; lat. 28–35·5 μ; crass. 12·5–14 μ. (Pl. **21**. figs. 36–39.)

Hab. Near Rhiconich, Sutherland (*West*). Ireland (*Archer*).

Some collections of Algæ from the boggy hollows in the Lewisian Gneiss of West Sutherland, which were rich in Desmids of the Western British type, such as *Docidium undulatum*, Bail., *Penium adelochondrum*, Elfv., *Euastrum intermedium*, Cleve, *E. pingue*, Elfv., and *Staurastrum elongatum*, Barker, also contained a most peculiar species of the genus *Tetraëdron*. It agrees with no described species of this genus, and I have not observed it from elsewhere.

The cell is more or less quadrate when seen from the front, with a broad excavation at each side, which gives it the appearance of a species of *Cosmarium* with a very wide and elongate isthmus. The apices are faintly retuse and the lateral angles are produced and somewhat attenuated, having a slight thickening at the extremity. Seen from the side the cell is elliptical; from the apex it is elliptical with attenuated poles, and exhibits a slight indentation in the middle of each side. The cell-wall is finely punctate, and extending from angle to angle across each half of the cell is a row of rather stronger and more distant punctæ disposed in the form of an arc. The greater part of the living cell is occupied by a single large chloroplast, with several irregular ridges and a central pyrenoid (fig. 36).

Several empty individuals were noticed which possessed a prominent slit down one face of the cell-wall, most probably indicating the place of escape of autospores (fig. 39).

[1] W. Schmidle, "Zur Kenntnis der Planktonalgen," in Hedwigia, xlv. (1905).

The outward form of this *Tetraëdron* recalled to my memory one of Archer's preliminary notes on a supposed new species of Desmid[1]. This brief preliminary account, like many others by the same writer, was unfortunately never followed by the promised detailed description. It is copied by Cooke[2], and reads as follows:—

"*Cosmarium platyisthmum*, Archer. Minute. In general outline in front, or broad view, much resembling, say, a section of a double railway-rail—that is to say, the isthmus very broad and comparatively long, thus the isthmus makes up a great proportion of the whole *Cosmarium*; the semi-cells are elliptic, much broader than high, the whole smooth; end view elongate compressed, extremities rounded. The lateral extremities of the semi-cells somewhat taper ere becoming rounded off, and the upper margins are notably retuse in the middle. Size not given. *Hab.* Ireland."

A comparison of the above description with the specimens from Scotland leaves no doubt as to the identity of the Irish and Scottish plants. As a further confirmation of this view, I may add that many of Archer's new species were collected in Connemara, and that the Alga-flora of West Ireland very closely resembles that of North-West Scotland. The similarity between the species occurring in certain districts of Connemara and those found in Western Sutherland is most striking. In fact, so far as their British distribution is concerned, many of them are only known to occur in these two areas.

Archer was in error in referring the plant to the Desmidiaceæ as a species of the genus *Cosmarium*, and he omitted to mention certain of its characteristic, although inconspicuous features.

6. CHODATELLA QUADRISETA, *Lemmermann*. (Pl. **21**. figs. 40–43.)

This genus *Chodatella* belongs to the subfamily Phytheliеæ of the Protococcaceæ (or Autosporaceæ), and was founded by Lemmermann[3] to include a number of free-floating unicells, furnished with long spines.

It is very closely allied to *Lagerheimia*, Chodat, differing only in the absence of tubercles at the base of the spines. Lemmermann enumerates seven species known up to 1898. Three of these—*C. ciliata*, (Lagerh.) Lemm., *C. amphitricha*, (Lagerh.) Lemm., and *C. radians*, (West) Lemm.—should clearly be united, reducing them to five, and another species discovered in 1902 makes a total of six known species.

Although many of the Algæ comprising the Phytheliеæ are constituents of the freshwater plankton, my recent experience is that they occur more frequently in the waters of small ponds such are found on old pasture-land, being intermingled with other free-floating Protococcaceæ of the genera *Ankistrodesmus*, *Scenedesmus*, *Tetraëdron*, &c.

[1] W. Archer in Journ. Dubl. Micr. Club, iv. (1880–5) p. 27.

[2] M. C. Cooke, Brit. Desm. 1886–7, p. 187.

[3] E. Lemmermann in Hedwigia, xxxviii. (1898) p. 309.

In October 1906 a collection of Algæ was made from a small pond in Studley Park, Warwickshire, which proved rather rich in some of the more minute species of the Protococcaceæ. One of these minute Algæ I have regarded as *Chodatella quadriseta*, Lemm.

The cells were elliptic-oblong, or oblong with rounded extremities, about $1\frac{1}{2}$ times longer than their diameter, and furnished towards each pole with a pair of widely divergent spines. The spines were attached not *at* the poles, but rather *below* them, and were so widely divergent as to appear almost laterally inserted. Thus the breadth of the Alga is considerably greater than the length, if the spines are reckoned in the measurements. The cell-wall was very delicate, and a large chloroplast occupied the greater part of the interior of the cell. As this chloroplast was to a great extent pressed up against the inner side of the cell-wall, it is parietal. It should be noted, however, that in many individuals two chloroplasts were present, one disposed towards each end of the cell, a condition most probably brought about by a separation of the original chloroplasts into two parts [1]. No pyrenoids were present in any individual examined.

In his description of the genus, Lemmermann states: "Chlorophora singula, parietalia. Nucleus amylaceus singulus."

As the specimens from Studley Park often possessed two chloroplasts, and no individual was noticed with any trace of pyrenoids, this statement requires modification. It is also fitting to once more point out that the presence or absence of pyrenoids in the chloroplasts of Green Algæ has no value as a generic character.

Lemmermann's description of *Chodatella quadriseta* is very brief:—"Cellulæ ovales vel subglobosæ, 4 μ latæ et 5·5 μ longæ, utroque polo 2 setis circ. 15 μ longis instructæ." It gives one the impression that the setæ are attached actually at the poles of the cells. The specimens from Studley Park had a length of 5·5–8 μ, a breadth of 3·4–5 μ, and the spines were 15–17·5 μ in length. They occurred in a habitat precisely similar to that in which Lemmermann discovered the species near Leipzig in 1898.

No reproductive stages were observed, and, owing to the relative scarcity of the species among a vast multitude of other minute green Algæ, I was unable to make cultures which were not at once choked with other Protococcoideæ. In fact, I was never able to find any *Chodatella* except in the original material.

[1] The fragmentation of the chloroplast in certain of the Protococcaceæ is not at all uncommon; *vide Ankistrodesmus falcatus* (Corda) Ralfs, var. *mirabilis*, G. S. West, Treatise British Freshw. Algæ, 1904, p. 223, fig. 94 E*a* (= *Rhaphidium polymorphum*, Fresen., var. *mirabile*, W. & G. S. West in Journ. Roy. Micr. Soc. (1897) p. 501, t. 7. ff. 9–13). Consult also *Ankistrodesmus fractus* (= *Rhaphidium fractum*, W. & G. S. West in Journ. Linn. Soc., Bot. xxxiv. (1899) p. 284); and *Ankistrodesmus Chodati* (= *Rhaphidium Chodati*, Tanner-Fullemann, in Bull. Herb. Boiss. sér. 2, vi. (1906) p. 158, fig. 11).

EXPLANATION OF THE PLATES.

PLATE 20.

Figs. 1–6. *Polychætophora simplex*, sp. n. × 400.

1–5. Vegetative cells from the side showing the flexuose bristles and the single chloroplasts.

6. Cell stained to show nucleus (*n*); the dark granules (*s*) are particles of starch.

Figs. 7–19. *Brachiomonas submarina*, Bohlin. × 1000.

7–9. Three vegetative cells to show variability of external form.

10, 11. Two individuals viewed from the anterior end to show the four lateral horns; 11 has three small pyrenoids (p^1, p^2, and p^3).

12. Individual stained with gentian-violet to bring out the nucleus (*n*), and to show the extension of the cytoplasm to the extremities of the hollow horns.

13. Individual after treatment with chlor-zinc-iodine: *p*, pyrenoid; *v*, vacuole.

14, 15. Anterior and side views of enlarged mother-cells containing four zoogonidia. These are disposed with their posterior horns directed towards a central point.

16. Gamete.

17. Zygospore.

18. Distended individual only observed in cultures in Knop's solution after about three months.

19. Monstrous specimen due to imperfect separation of two zoogonidia during their formation within the mother-cell.

Figs. 20–30. *Kirchneriella subsolitaria*, sp. n. × 1000.

20–24. Solitary individuals; 20 is rather an unusual form.

25. Solitary individual within a delicate membrane (probably the old wall of a mother-cell).

26, 27. Colonies of two cells.

28–30. Colonies of four cells; all enclosed in firm but delicate membranes, which are the old walls of the original mother-cells, but not gelatinized.

PLATE 21.

Figs. 31–35. *Phyllobium sphagnicola*, sp. n. × 500.

31. Edge of *Sphagnum*-leaf with nine resting-cells of the Alga attached to the ramifying vegetative threads: *r.c.*, resting-cell; *v.c.*, vegetative cell.

32–35. Resting-cells attached to vegetative threads, isolated from the *Sphagnum*-leaves.

Figs. 36–39. *Tetraëdron platyisthmum*, (Archer) nob. × 500.

36. Cell showing chloroplast with one pyrenoid (*p*).

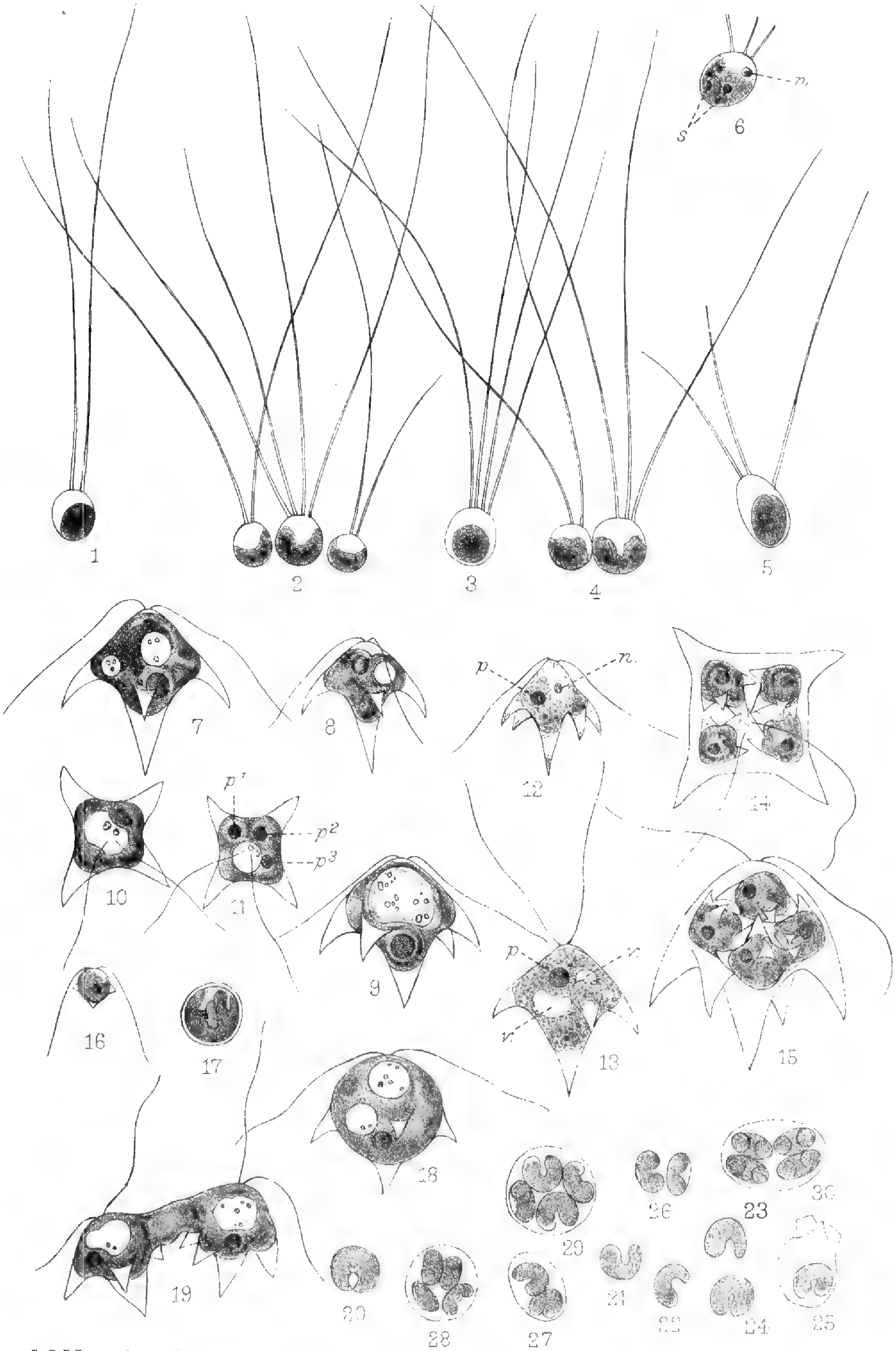
37. Empty cell in three positions.

38. Empty cell.

39. Empty cell with longitudinal slit (*x*), possibly formed for the escape of autospores.

Figs. 40–43. *Chodatella quadriseta*, Lemm. × 1000.

In 41 and 42 the chloroplast has become separated into two parts.



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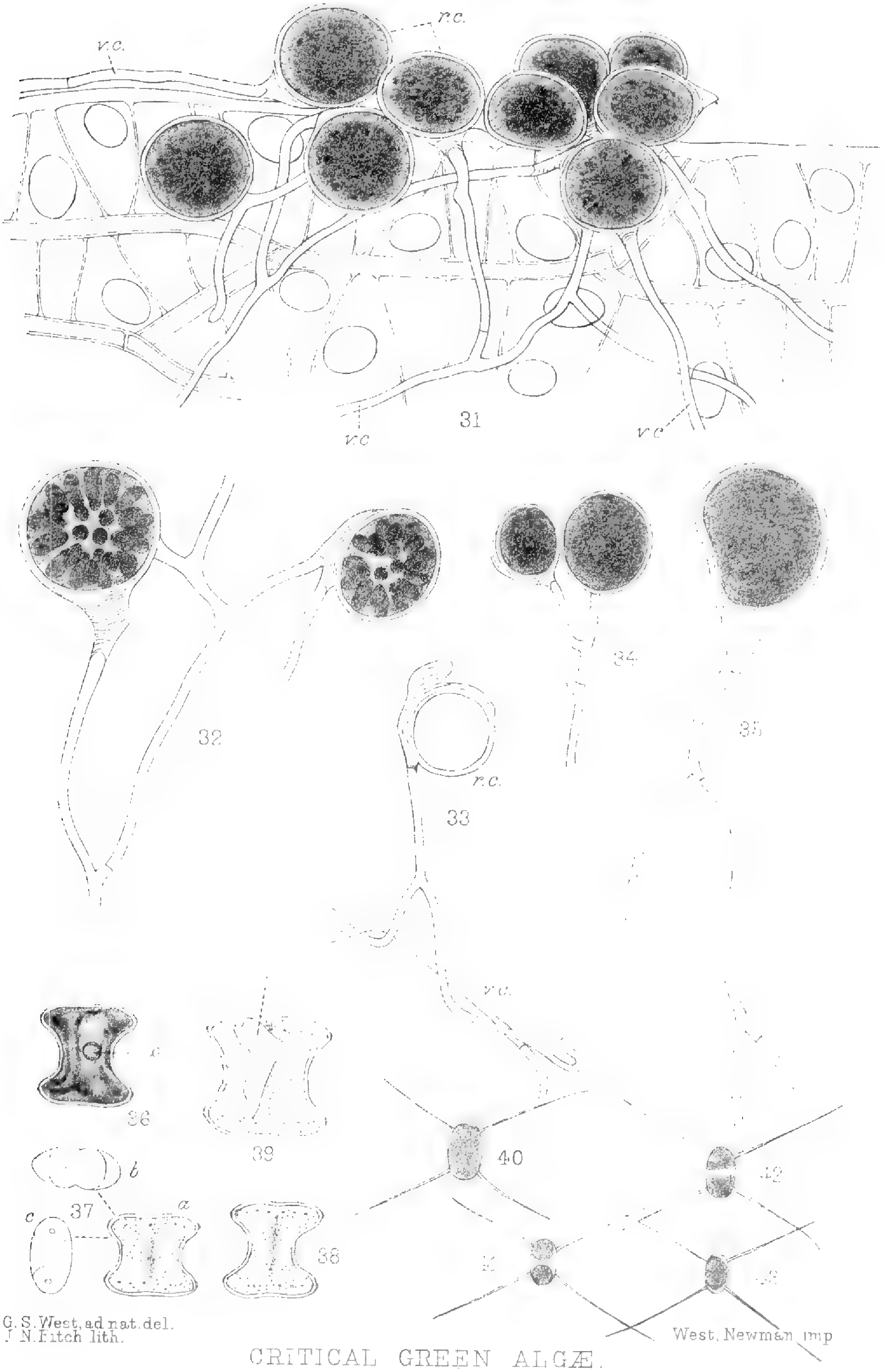

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THE JOURNAL
OF
THE LINNEAN SOCIETY.

VOL. XXXVIII. BOTANY. No. 266.

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EXPLANATION OF THE PLATES.

PLATE 20.

Figs. 1–6. *Polychætophora simplex*, sp. n. × 400.

1–5. Vegetative cells from the side showing the flexuose bristles and the single chloroplasts.

6. Cell stained to show nucleus (*n*): the dark granules (*s*) are particles of starch.

Figs. 7–19. *Brachiomonas submarina*, Bohlin. × 1000.

7–9. Three vegetative cells to show variability of external form.

10, 11. Two individuals viewed from the anterior end to show the four lateral horns; 11 has three small pyrenoids (p^1, p^2, and p^3).

12. Individual stained with gentian-violet to bring out the nucleus (*n*), and to show the extension of the cytoplasm to the extremities of the hollow horns.

13. Individual after treatment with chlor-zinc-iodine: *p*, pyrenoid; *v*, vacuole.

14, 15. Anterior and side views of enlarged mother-cells containing four zoogonidia. These are disposed with their posterior horns directed towards a central point.

16. Gamete.

17. Zygospore.

18. Distended individual only observed in cultures in Knop's solution after about three months.

19. Monstrous specimen due to imperfect separation of two zoogonidia during their formation within the mother-cell.

Figs. 20–30. *Kirchneriella subsolitaria*, sp. n. × 1000.

20–24. Solitary individuals; 20 is rather an unusual form.

25. Solitary individual within a delicate membrane (probably the old wall of a mother-cell).

26, 27. Colonies of two cells.

28–30. Colonies of four cells; all enclosed in firm but delicate membranes, which are the old walls of the original mother-cells, but not gelatinized.

PLATE 21.

Figs. 31–35. *Phyllobium sphagnicola*, sp. n. × 500.

31. Edge of *Sphagnum*-leaf with nine resting-cells of the Alga attached to the ramifying vegetative threads: *r.c.*, resting-cell; *v.c.*, vegetative cell.

32–35. Resting-cells attached to vegetative threads, isolated from the *Sphagnum*-leaves.

Figs. 36–39. *Tetraëdron platyisthmum*, (Archer) nob. × 500.

36. Cell showing chloroplast with one pyrenoid (*p*).

37. Empty cell in three positions.

38. Empty cell.

39. Empty cell with longitudinal slit (*x*), possibly formed for the escape of autospores.

Figs. 40–43. *Chodatella quadriseta*, Lemm. × 1000.

In 41 and 42 the chloroplast has become separated into two parts.

A Revision of the Genus *Illigera*, Blume.

By STEPHEN TROYTE DUNN, B.A., F.L.S., Superintendent of the Botanical and Forestry Department, Hongkong, China.

[Read 16th January, 1908.]

ILLIGERA, Blume, Bijdr. 1153 (1826); Ann. Sci. Nat. 2 sér. ii. 95 (1834); Nees, Syst. Laur. 703 (1836); Endl. Gen. 324 (1836); Lindl. Key to Nat. Syn. 202 (1836); Meissn. Gen. (1843) 327; Lindl. Veg. Kingd. 718 (1846); Miq. Fl. Ind. Bat. i. I. (1855) 1094; Meissn. in DC. Prodr. xv. i. 250 (1864); Miq. Ann. Mus. Bot. Lugd.-Bat. ii. 214 (1866); Benth. & Hook. f. Gen. Pl. i. 689 (1865); Baill. Adans. v. 186 (1865), Hist. des Pl. ii. 445 (1870); C. B. Clarke in Hook. f. Fl. Br. Ind. ii. 460 (1879); Pax in Engl. u. Prantl, Pflanzenfam. III. ii. 126 (1889); Boerl. Fl. Ned. Ind. i. (1890) 480; King, Mat. Fl. Malay Penins. No. 9, in Journ. As. Soc. Beng. lxvi. II. (1897) 342.

Henschelia, Presl, Rel. Haenk. ii. 81, t. 63 (1831).

Gronovia, Blanco, Fl. Filip. ed. i. 186 (1837), non Linn.

Coryzadenia, Griff. in Proc. Linn. Soc. i. (1846) 281, Notul. iv. 356 (1854).

Frutices ope petiolorum scandentes. Folia alterna, 3-(vel 5)-foliolata, foliolis petiolatis. Inflorescentiæ cymosæ, bracteolatæ. Flores hermaphroditi; calycis tubus ovoideus, superne constrictus, ovario adnatus; limbus 5-partitus, lobis patentibus, valvatis, oblongis, deciduis; petala 5, sepalis textura similia; stamina 5 cum glandulis 5 oppositipetalis alternantia, ima basi nectariis duobus lateralibus vel dorsalibus appendiculata, nectariis tubulosis extrorsis conspicuis vel solidis obscuris, antheris ovatis, lateraliter valvatim dehiscentibus; ovarium 1-loculare; ovulum unicum pendulum; stylus brevis, in stigma peltatum undulatum vel varie incisum expansus; fructus indehiscens, siccus, 2–4-alatus; semen oblongum, cotyledonibus plano-convexis, radicula inclusa. Genus gerontogeum tropicum species 12 asiaticas includens et unam africanam.

Blume founded the genus in 1826 (*l. c.*) on two Javan climbers with trifoliolate leaves, inferior one-celled ovaries, and a remarkable floral structure recalling that of the Lauraceæ. Eleven more species sharing these peculiar characteristics have now been added, some of which were at first thought to represent distinct genera. *Henschelia* was founded by Presl on a Philippine specimen collected by Haenke, and a full description with an elaborate figure was published by him (Rel. Haenk. ii. 81, t. 63); from a perusal of these it would appear as though his plant differed from Blume's species in many important particulars, the ovary being represented as superior with two erect basal ovules and the staminal whorl as also widely different. The

similarity in habit, foliage and inflorescence, however, led Miquel (Fl. Ind. Bat. i. I. 1094) to reduce *Henschelia* tentatively to *Illigera*; and this reduction is now confirmed by Mr. Elmer D. Merrill, who has compared side by side the types of *Henschelia luzonensis*, Presl, and *Illigera Meyeniana*, Kunth, which he finds to be conspecific.

Gronovia and *Coryzadenia* were proposed by their authors for species whose affinities to *Illigera* they did not recognize, probably on account of the inaccuracy of Blume's original diagnosis.

At the time that Blume wrote, mature fruits of the two species before him were not known, and it was from an examination of immature material, and under the influence of the recognized affinities of his genus with the Lauraceæ, that he was unfortunately led to the erroneous conclusion that the fruit of the genus was a wingless drupe and that the cotyledons of the embryo were convolute. These conjectural characters Blume indiscreetly included in the essential diagnosis of his genus, and when nearly forty years later Meissner had five species, agreeing closely in floral characters, under consideration for his revision of *Illigera* in DeCandolle's 'Prodromus' (xv. i. 251), he very doubtfully included the only one of which ripe fruit was known (*I. dubia*, Span.), because it had a dry winged fruit and not a wingless drupe. In the following year (1865) Hooker fil. revised the genus for the 'Genera Plantarum.' He had access to specimens of several Indian species with almost identical flowers but, like the above, with winged fruit. With characteristic clearness of judgment Hooker saw for the first time that Blume's diagnosis was wrong, no examples of mature wingless fruit had been found, and he amended this generic character accordingly. Of the 13 species now known 10 have winged fruit, while in the remainder ripe fruit is still undescribed. It is therefore in the highest degree probable that the fruit of *Illigera* is invariably winged.

The character of the staminal whorl and its accessory organs is so peculiar that it is desirable to describe it in detail. The stamens are opposite to the outer segments of the perianth and dehisce by two lateral valves which open from the inner side and remain fixed, at any rate for a time, by their outer or by their upper edges. Between them and the inner whorl of the perianth are two sets of organs. The outer consists of five glands opposite to the inner perianth segments; this might be looked upon as the disc, for in the young bud this whorl is an obscurely toothed ring on the inner side of which the stamens arise. The teeth alternate with the stamens and develop into the glands. When fully formed they are sessile or shortly stalked globular bodies or shallow fleshy, often lobed cups. [Or, on the other hand, the glands of the outer whorl might be regarded as staminodes, homologous with an outer whorl of stamens in Lauraceæ.] The inner whorl comprises ten nectaries associated in pairs with the stamens, and either actually attached

to their base, or free, and in one case enclosed by the revolute margins of the flat filament. They apparently arise as papillæ at the base of the developing stamens. When fully developed, they form shortly stalked membranous cups with open spathe-like acute or truncate entire or serrulate hoods, or else, the spathe being nearly closed, they become oblique club-shaped receptacles with longitudinal openings; in all cases, the insertion is slightly behind or outside of the filaments and the opening is always extrorse. When rudimentary, the nectaries form small hemispherical or club-shaped excrescences or stalked globular appendages at the base of the stamens.

Twelve of the species now known inhabit a well-defined geographical area, including N.E. India, Burma, the Malay Peninsula and Archipelago, the Philippine Islands, Formosa, and tropical China. The remaining species is widely distributed in tropical Africa.

The systematic position of the genus has been the subject of much discussion from the time of its discovery, and succeeding botanists have placed it in association with widely different groups according as they were more impressed by one or other of its characteristics. Blume located it near Lauraceæ, in consequence of the valvular dehiscence of its stamens and its solitary pendulous ovule, and in spite of its inferior ovary, which gave it, he said, the same relation to that order as *Vaccinium* has to Ericaceæ (Ann. Sci. Nat. 2 sér. ii. (1834) 95). He recognized also its relation to *Gyrocarpus*, and placed them together under the name of Illigereæ. Endlicher (Gen. (1836) 2069) associated the same two genera under the name of Gyrocarpeæ and placed them near Daphnoideæ. The close relation of *Hernandia* with *Illigera* was not seen till thirty years later, but in order to understand the systematic history of the latter it will be necessary to trace also that of the former. Endlicher (*l. c.*) placed *Hernandia* in Santalaceæ. Nees (Syst. Laur. (1836) 703), and originally Lindley (Key to Nat. Syn. (1836) 202), followed Blume. Later, in his Vegetable Kingdom (1846, p. 718), Lindley referred Gyrocarpeæ to Combretaceæ, *Hernandia* to Thymelæaceæ. Meissner (DC. Prodr. xv. i. (1864) 251) restored Gyrocarpeæ to Lauraceæ, and made *Hernandia* the type of a natural order Hernandiaceæ in the same affinity. Bentham and Hooker (Gen. Pl. i. (1865) 689), following Lindley, placed Gyrocarpeæ again in Combretaceæ, adding to them Martius's *Sparattanthelium*, while *Hernandia* was referred to Lauraceæ. Meanwhile Baillon had pointed out (Adans. v. (1865) 186) that *Hernandia* might be regarded as a diclinous reduced type of *Illigera*. If, indeed, a hermaphrodite flower be theoretically constructed from the male and female flowers of *Hernandia*, the peculiar floral characters of *Illigera* are almost exactly reproduced. In 1885 Solereder (in Bot. Centralbl. xiii. 163) showed that the Gyrocarpeæ differed from the Combretaceæ and agreed with the Lauraceæ in important anatomical characters, namely, the absence of internal phloem and the presence of secreting cells. Four years later (in Engl. Bot. Jahrb. x. (1889) 511), he

investigated the anatomy of the Gyrocarpeæ in greater detail and adduced an additional character, the presence of rhaphides, as confirming the relationship with Lauraceæ. Almost simultaneously Pax (in Engl. u. Prantl, Pflanzenfam. III. ii. (1889) 126) added Bentham and Hooker's Gyrocarpeæ to Hernandiaceæ and placed the order near Lauraceæ, and this arrangement is probably a fair representation of our present knowledge of these genera.

Illigera naturally falls into two distinct sections according to the character of the nectaries, six of the twelve species whose flowers are known having these organs comparatively large and tubular, while in the remainder minute solid glands take their place. Blume's two original species, upon which he founded the genus, happen to have belonged one to each section, and one of the characters upon which he relied to distinguish them, and which he used for the name of one of them (*I. appendiculata*), was this sectional character. I cannot, therefore, do better than apply the name *Appendiculatæ* to the six species having large nectaries, and *Parviglandulatæ* to the remainder.

Key to the Species of Illigera.

1	Leaves ternate	2
	Leaves quinate	*pentaphylla*, Welw.
2	Infructescence with stiff setose hairs	*villosa*, C. B. Clarke.
	Infructescence glabrous or softly hairy	3
3	Nectaries inflated, large	4
	Nectaries obscure	9
4	Calyx-tube clothed with spreading red hairs (yellow in a dried state)	5
	Calyx-tube glabrous or softly pubescent	6
5	Calyx-lobes externally tomentose	*dasyphylla*, Miq.
	Calyx-lobes glabrous or puberulous	*rhodantha*, Hance.
6	Calyx-tube glabrous or nearly so	*ternata*, Dunn.
	Calyx-tube softly and densely pubescent	7
7	Leaves with tufts of hair in vein-axils	8
	Leaves glabrous or uniformly hairy	*trifoliata*, Dunn.
8	Veins immersed	*appendiculata*, Blume.
	Veins prominently reticulate on the lower surface	*khasiana*, C.B.Clarke.
9	Filaments cylindric	10
	Filaments winged	12
10	Leaf-veins ascending	11
	Leaf-veins patent, stamens bearded	*pulchra*, Blume.
11	Leaves glabrous, lanceolate	*parviflora*, Dunn.
	Leaves pubescent, ovate-cordate	*cordata*, Dunn.
12	Calyx-tube puberulous	*celebica*, Miq.
	Calyx-tube glabrous	*platyandra*, Dunn.

SECT. 1. **Appendiculatæ.**

1. ILLIGERA APPENDICULATA, *Blume, Bijdr.* 1153 (1826), *Ann. Sci. Nat.* 2 sér. ii. 95 (1834); *Nees, Syst. Laur.* 703 (1836); *Miq. Fl. Ind. Bat.* i. I. 1094 (1855), *Ann. Mus. Bot. Lugd.-Bat.* ii. (1866) 214; *Meissn. in DC. Prodr.* xv. I. 250 (1864).—dubia, *Span. in Linnæa,* xv. 187 (1841)?

Descriptioni addenda: petala 7 mm. longa, staminibus longiora, nectariis staminalibus obovatis, basi breviter cupularibus, 2 mm. longis, membranaceis, apice truncatis, integris, glandulis disci sphæroideis sessilibus.

MALAYA: Java, *Horsfield,* n. 691; *Binnendijk,* "*Illigera pulchra*"; *Teijsmann,* "*Illigera pulchra,* Bl. Hort. Bogor." Sumatra, *Beccari,* n. 950. New Guinea *fide* Schum. et Lauterb.

True *I. appendiculata,* Blume, is a plant with ovate leaflets, hairy in the vein-axils beneath, and is at present known only from the Malayan Islands. The plant so called by Kurz and later Indian botanists is No. 4 below. *I. dubia,* Span., was distinguished by Miquel from *I. appendiculata,* Blume, by its winged fruit, under the impression that the fruit of the latter was a wingless drupe. As it has been shown above that this is almost certainly not the case, it becomes highly probable that *I. dubia,* Span., is a synonym and it is so inserted, though not with certainty, above.

2. I. KHASIANA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* ii. 460 (1879).

INDIA: E. Bengal, *Griffith,* n. 4340, Khasia, *Griffith.* Mowlong, Khasia, *Clarke,* nn. 15814, 44906 A. Khasia, 13.8.50, *Hook. f. & Thomson.* Assam, *Serrion,* n. 75.

Descr. addenda: petala 7 mm. longa, utrinque pubescentia, nectariis 2½ mm. longis, eis *I rhodanthæ* similibus.

3. I. TERNATA, *Dunn,* comb. nov.—I. Meyeniana, *Kunth ex Walp. in Nov. Act. Nat. Cur.* xix. Suppl. 1. (1843) 410; *Meissn. DC. Prodr.* xv. I. 250 (1864).—I. appendiculata, *Vidal, Sinops.* t. 48. f. 7 (1883), *non Blume.*—I. luzonensis, *Merrill in Philipp. Gov. Lab. Publ.* xvii. (1904) 18; *non* Henschelia luzonensis, *Presl.*—Gronovia ternata, *Blanco, Fl. Filip.* ed. 1. 186 (1833).

Descr. addenda: petala 7–10 mm., staminibus æquilonga, nectariis staminalibus eis *I. appendiculatæ* similibus.

INS. PHILIPP.: Luzon, common. CHINA: Formosa, *Henry,* n. 703, *Playfair,* n. 61.

4. I. TRIFOLIATA, *Dunn,* comb. nov.—I. Coryzadenia, *Meissn. DC. Prodr.* xv. I. 251 (1864); *C. B. Clarke in Hook. f. Fl. Br. Ind.* ii. 460 (1879).—I. appendiculata, *Kurz, For. Fl. Burma,* i. 469 (*non Blume*); *King in Journ. As. Soc. Beng.* lxvi. II. (1897) 343.—Coryzadenia trifoliata, *Griff. Notul.* iv. 356 (1854).

India: Khasya? *Griffith.* Tenasserim, *Griffith*, n. 449, *Helfer*, n. 4341. Andamans, *Clarke*, n. 25938. Straits Settlements: Selangor, *Ridley*, n. 8599; Malacca, *Lobb*; Perak, *King*, nn. 2776, 2570.

Var. Kurzii, *King, l.c.*—I. Kurzii, *C. B. Clarke, l. c.*

India: Tenasserim, *Helfer*, n. 4341. Straits Settlements: Malacca, *Maingay*, n. 1253 (Kew Distrib., n. 649), 1970 (Kew Distrib., n. 650).

Descr. addenda: petala 7 mm. longa, staminibus longiora, nectariis staminalibus ovalibus, inflatis, sessilibus, superne poro laterali provisis, 3 mm. longis.

Kurz's mistake in referring this plant to *I. appendiculata*, Blume, has already been referred to under that species. It appears that Blume's plant, though really easily distinguishable, and well described from authentic specimens by Miquel, was not understood by Kurz and Clarke. This may have arisen from the fact that Teijsmann, as Miquel remarked, sent out specimens of it from the Buitenzorg Botanic Gardens under the name of *I. pulchra.*

5. I. dasyphylla, *Miq. Fl. Ind. Bat.* i. i. (1860) 1094, *Suppl.* i. 333, tab. 1; *Ann. Mus. Bot. Lugd.-Bat.* ii. 215; *Meissn. in DC. Prodr.* xv. i. 251.

Malaya: W. Sumatra (*fide Miq.*).

6. I. rhodantha, *Hance, in Journ. Bot.* xxi. (1883) 321.

China: Kwantung, Lienchow River, *Hance* 22072; Lo Fau Shan, Hongkong, *Herb.* No. 337; Kwangsi, Lungchow, *Morse*, nn. 716, 434. Indo-China: Hills about Cu Phap, *Balansa*, n. 4120. Forests between Phuong-Lam and Cho-ho, *Balansa*, n. 4121.

Descr. addenda: petala 10 mm. longa, staminibus longiora, nectariis staminalibus breviter stipitatis, obovatis, basi breviter cupularibus, apice rotundatis, serrulatis.

Some of the above specimens, though characterized by the distinct inflorescence and floral characters of Hance's plant, vary considerably in the shape and hairiness of the leaves, which are oblong and subglabrous in Morse's Kwangsi specimens, ovate and densely pubescent in Balansa's plants from Tonkin.

7. I. pentaphylla, *Welw. in Trans. Linn. Soc.* xvii. (1869) 26.

Africa: Angola, *Welwitsch*, n. 1763.

Sect. 2. **Parviglandulatæ.**

8. I. pulchra, *Blume, Bijdr.* (1826) 1153, *Ann. Sci. Nat.* 2 sér. ii. 95 (1834); *Miq. Ann. Mus. Bot. Lugd.-Bat.* ii. 213, *Fl. Ind. Bat.* i. i. 1094.—I. lucida, *Teijsm. & Binn. in Nat. Tijdsch. Ned. Ind.* xxvii. (1864) 29; *King in Journ. As. Soc. Beng.* lxvi. ii. (1897) 344.

MALAY ARCH.: Java, Banca, *Binnendijk*. STRAITS SETTLEMENTS: Perak, *Scortechini*, n. 1610.

Descr. addenda: petala ligulata, 6 mm. longa, staminibus æquilonga, basi barbata, nectariis staminalibus globosis, sessilibus, minutis.

The redescribing of this species under the name of *Illigera lucida* by Teijsmann was probably another mistake due to having the name *I. pulchra* wrongly applied to *I. appendiculata* in the Buitenzorg Botanic Gardens.

9. ILLIGERA PARVIFLORA, *Dunn*, sp. n. Frutex scandens, inflorescentia excepta, glaber. Folia trifoliolata, petiolo 4–5 cm. longo; foliola lanceolata, lateralia valde obliqua, 5–7 cm. longa, chartacea, acuminata, basi cuneata. Paniculæ pedunculatæ, angustæ, foliis breviores, pedunculis 4 cm. longis. Calycis tubus dense pubescens, lobis 4 mm. longis glabris; petala interne glabra, externe pubescentia, sepalis æqualia; stamina 7 mm. longa, puberula, nectariis staminalibus minutis sessilibus rotundatis, glandulis disci minutis stipitatis.

CHINA: Kwantung, N.W. River, *Ford*, n. 260.

10. I. CORDATA, *Dunn*, sp. n. Frutex scandens. Caulis striatus puberulus, glabrescens. Folia trifoliolata, petiolis 4–12 cm. longis, foliolis suborbicularibus vel ovatis, 7–12 cm. longis, chartaceis, ubique molliter pubescentibus, tandem subglabris, subabrupte acuminatis, terminalibus symmetrice, lateralibus oblique cordatis. Flores in cymas densas, pedunculatas, pubescentes, foliis breviores, dispositi, pedunculis communibus 4–6 cm. longis, bracteolis oblongis, ad. 3 mm. longis. Flores flavi; calycis tubus dense pubescens; lobi 5 mm. longi, interne pubescentes; petala sepalis similia; stamina 3 mm. longa, puberula, nectariis staminalibus oblongis, minutis, glandulis disci trilobis $1\frac{1}{2}$ mm. latis; stylus hirsutus. Fructus siccus, tetrapterus, 3–5 cm. latus, 25–35 mm. longus, subglaber, alis lateralibus aliorum dimidia excedentibus vel eis æqualibus.

CHINA: Yunnan, *Hancock*, n. 538, *Henry*, nn. 9902, 9902 A, 10649.

11. I. CELEBICA, *Miq. Ann. Mus. Bot. Lugd.-Bat.* ii. 215; *Meissn. in DC. Prodr.* xv. I. 251.

MALAYA: Celebes (*fide Miq.*).

12. I. PLATYANDRA, *Dunn*, sp. n. Frutex scandens, floribus exceptis glaber. Folia superiora trifoliolata, petiolis 5–7 cm. longis; foliola ovata vel ovato-oblonga, basi rotundata vel subcordata, venis secundariis utroque latere 4–5 erecto-patentibus, curvatis. Flores in cymas compactas, petiolis breviores, vel in paniculas foliosas dispositi, bracteolis minutis paucis. Calycis tubus glaber; lobi oblongi 5 cm. longi, extus acumine, intus omnino pubescentes, 5 mm. longi, acuti; petala angustiora, æquilonga, ubique pubescentia; stamina petalis duplo longiora, filamentis alatis superne angustatis, anguste revolutis, 10 mm. longis, basi $2\frac{1}{2}$ mm. latis, minute

puberulis, nectariis rudimentariis alis filamenti obtectis, glandulis disci obsoletis. Stylus pubescens. Fructus tetrapterus, alis coriaceis striatis, lateralibus 2–3 cm. longis, cæteris duplo brevioribus, ovatis, glabris.

CHINA: Kwantung, Hongkong Island, Hongkong, *Herb.* No. 653. INDO-CHINA: woods, Cu Phap, *Balansa*, n. 3161. PHILIPPINE ISLANDS, *Wallis*, n. 136.

Flowers unknown.

13. I. VILLOSA, *C. B. Clarke in Hook. f. Fl. Brit. Ind.* ii. 461.

INDIA: Naga Hills, *Clarke*, n. 41843.

Species excludenda.

I. OBTUSA, *Meissn. DC. Prodr.* XV. I. 251.

From the characters there given the plant is clearly to be rejected from the genus.

On some new Species of Coniferæ from the Island of Formosa. By BUNZŌ HAYATA (Tōkyō). (Communicated by W. BOTTING HEMSLEY, F.R.S., F.L.S.)

(PLATES 22 & 23.)

[Read 16th January, 1908.]

[THE following pages were in type, and the Plates ready for printing, when the new species contained in it were published in 'The Gardeners' Chronicle,' 28th March, 1908, p. 194. The Council were unaware that this paper had been sent to the late Dr. M. T. Masters for publication, but his unexpected death induced the author to forward another manuscript and to ask that it might be presented to the Linnean Society, in the belief that the original paper would not be published.—SEC. L. S.]

THE following *Pinus* was first collected by Mr. C. Owatari in the mountainous districts of the Island. I was not able to investigate it with any satisfaction until Mr. G. Nakahara brought me some mature cones of this plant. The following description is drawn from both materials.

PINUS FORMOSANA, *Hayata*, sp. n. (Pl. 22.)

Ramuli teretes, perularum rudimentis notati, novelli pubescentes. Gemmæ ovatæ, perulatæ, perulis acutis membranaceis margine laceratis. Folia in quovis fascicculo quinque, fasciulis approximatis, acerosa, rigidula, 6–8 cm. longa, arcuata sed non torta, apice acuta, dorso plana, facie acute carinata, triangularia in sectione, margine et in carina remote serrulata. Strobili erecti, ovato-elliptici, obtusi, e squamis circ. 40 compositi, 7–9 cm.

longi, 4–6 cm. lati, squamis ellipticis basi cuneatis sursum rotundatis leviter reflexis, 3 cm. longis, 1½ cm. latis, coriaceo-crassis et sublignescentibus concavis badio-fuscis, dispermis sed abortu monospermis. Bracteæ brevissimæ. Semina ovata, apice obtusa, 10 mm. longa, 6 mm. lata. Testa coriacea, pallide ferruginea glabra. Ala membranacea, tenuis, cultriformis, 2 cm. longa, 8 mm. lata.

Hab. Shōkakurin, leg. C. Owatari, mense Januario, anno 1898; Yagatayama, Taichū, leg. G. Nakahara, mense Februario, anno 1907.

This *Pinus* is very near *P. parviflora* Sieb. et Zucc., but differs from that by the shape of the cones, which in the new species are usually reflexed and especially so in the lower scales. The wings of the seeds are much larger than those of *P. parviflora*.

According to the information from Mr. G. Nakahara, the plant grows in the mountainous districts of the Taichū prefecture, at an altitude of 1500 m. Forming a forest along a valley, parallel to the Camphor forests, this pine gives the most remarkable feature to the vegetation of this district. Attaining a height of about 15 m., and a diameter of a little less than 1 m., it has an outline of a conical form, its branches spreading quite loosely upwards from the middle of the trunk, and downwards to about the reach of one's arms. The trunk is greyish white, very straight like a fir and the texture of the bark is very similar. The distribution of this *Pinus* is rather local, being limited to the western slope of the central mountain-ranges in the middle part of the island. It grows mostly on clay slates.

The following *Juniperus* was found on the top of Mt. Morrison at an altitude of about 4000 m., and was first collected by Mr. Shimoyama. Although the same mountain has since been botanized by several collectors, the specimens brought to me were but fragments of a barren branch. I could get no more information about this species than that it is something like *Juniperus chinensis*, Linn., until Mr. T. Kawakami gave me a perfect specimen. Examining this material, I find that it is very different from *J. chinensis*, Linn. The following description is mostly based upon Mr. T. Kawakami's specimens.

JUNIPERUS MORRISONICOLA, *Hayata*, sp. n.

Rami teretes; ramuli novelli virides, trigoni. Folia omnia lanceolata, apice acerosa patentiuscula, 3–4 mm. longa, 1 mm. lata, supra concava, glaucescentia, subtus leviter carinata. Flores masculi ad ramulos brevissimos terminales ovoidei, 4 mm. longi, 2 mm. lati; stamina 8, filamentis in squamum peltatis, squamis suborbicularibus, 1½ mm. diametro æquantibus, loculis antheræ 3. Flores fœminei ad ramulos brevissimos terminales, basi foliis squamiformibus bracteisque 6–9 oppositis suffulti, squamis intimis 3, ovatis acutis verticillatis patentibus. Ovulum terminale, solitarium, a squamis

intimis circumdatum, oblongum, apice attenuatum. Galbulus globosus vel oblongus, 6 mm. longus, extus bractearum apicibus notatus. Semina solitaria, globoso-ovoidea, 5 mm. longa, 4 mm. lata; testa ossea sulcata; embryo normalis; cotyledones 2.

Hab. ad verticem montis Morrison, 13200 ped. alt., leg. Shimoyama, anno 1899; leg. R. Torii, anno 1900; leg. S. Nagasawa, anno 1905 (no. 585); leg. T. Kawakami, mense Octobro, anno 1906 (no. 2142, fr.).

This new plant resembles *J. chinensis* in habit, but is easily distinguished by its solitary ovule on a short branchlet and by the shape of its cone. The leaves have a large single resin-canal near the phloem. So far, the plant does not seem to have dimorphic leaves, all the specimens we have at present having but one kind of leaf.

Cunninghamia was hitherto a monotypic genus, having only *C. sinensis*, R. Br. It is therefore most remarkable that we have here an addition of another species to this interesting genus. The new *Cunninghamia* here described was kindly sent to me by Mr. T. Kawakami, Government Expert of Formosa. It was obtained by Mr. Konishi on Mt. Rantaizan at an altitude of about 2000 m. It is very rare in the coniferous forests and attains a considerable height; it affords a good timber, which bears much resemblance to that of *Chamæcyparis*.

CUNNINGHAMIA KONISHII, *Hayata*, sp. n. (Pl. **23**.)

Arbor; rami omnes teretes, glabri, foliorum spiraliter confertorum cicatricibus notati. Gemmæ floriferæ nudæ, depresso-globosæ, bracteis depresso-ovatis brevissime aristato-acutis. Folia ramorum veteriorum spiraliter conferta, adnato-decurrentia, anguste lineari-falcata, incurvo-erecta, acuta, dorso leviter carinata, ramulorum juvenilium longiora, ascendento-patentia, lineari-lanceolata, 15 mm. longa, $2\frac{1}{2}$ mm. lata, ad basin oblique torta, apice obtusiuscula, margine sub lente serrulata, rigida, coriacea, utrinque pagina glaucescentia et striis duabis stomatibus multi-seriatis cincta, octovum in annum virentia, demum exarida sensim soluta. Strobili maturi ovato-globosi, 20 mm. longi, 15 mm. lati; squamæ rotundatæ, mucronatæ, basi distincte unguiculatæ, ungue brevo, lamina dilatata cordata late depresso-ovata, margine integra, lignescentes, sursum coriaceæ et marginem versus subundulatæ, dorso apice leviter carinatæ, glabræ; bracteis obsoletis; squamulæ 3 in medio laminæ, distinctæ, fimbriatæ, crenulatæ. Semina 3, ad squamulorum basin affixa reversa libera, ovato-elliptica, testa coriacea duriuscula, ala angusta cincta; embryo ignotus.

Hab. in monte Rantaizan, Nanto, ad 7000 ped. alt., leg. N. Konishi, mense Julio, anno 1907.

Mr. T. Kawakami informs me that this new plant is intermediate in habit between *Cunninghamia* and *Taiwania*. On examining the specimen carefully, I find the cone of the plant has a secondary squama, and should

therefore be undoubtedly referred to *Cunninghamia*. The leaf has stomata on both surfaces, while that of *C. sinensis* has none on the upper surface, or a very few. In the case of *Taiwania*, the stomata are found on both surfaces of the leaf. The new *Cunninghamia* differs essentially from *C. sinensis* by the arrangement and the shape of the leaves, smaller cones and broader squamæ. The timber is like that of other Conifers, the bark is reddish brown and in all respects is very like that of *Chamæcyparis*; but it has a peculiar odour unlike other Conifers. The leaf of *C. Konishii* is more durable than that of *C. sinensis*; the former lasts for eight, the latter for five years only.

In conclusion, I must express my hearty thanks to Prof. J. Matsumura under whose special permission this work has been carried out.

EXPLANATION OF THE PLATES.

Plate 22.

PINUS FORMOSANA, Hayata.

Fig. 1. A cone after dispersing the seeds.
2. A young cone.
3. A scale of the same, seen from within.
4. The same, seen from without; *br*=bract.
5. A scale, taken from a little below the middle portion of a mature cone.
6. A scale, taken from the middle portion of the same cone, seen from without.
7. The same, seen from within.
8. A scale, taken from a little above the middle portion of the same cone.
9. A scale.
10. The section of a leaf. *f*=fibro-vascular bundles; *r*=resin-canal.

Figs. 1 and 2, natural size; the rest are all more or less magnified.

Plate 23.

CUNNINGHAMIA KONISHII, Hayata.

Fig. 1. A branch, bearing a cone.
2. A leaf (outer or under surface); those portions which bear stomata are shown by dots.
3. A leaf (inner or upper surface).
4. Diagrammatic section of a leaf. *rc*=resin-canal; *Trf*=transfusion tissue; *fvb*=fibro-vascular bundles.
5. A scale of the cone (taken from the upper part of the cone; dorsal view).
6. The same (ventral view); traces of seeds are clearly seen.
7. A scale of the cone (taken from middle part of the cone; ventral view); two lateral seeds are clearly seen, the middle one taken off.
8. Seed.
9. The same, seen from the other side.

Fig. 1, natural size; the rest are all more or less magnified.

intimis circumdatum, oblongum, apice attenuatum. Galbulus globosus vel oblongus, 6 mm. longus, extus bractearum apicibus notatus. Semina solitaria, globoso-ovoidea, 5 mm. longa, 4 mm. lata; testa ossea sulcata; embryo normalis; cotyledones 2.

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Cunninghamia Konishii, *Hayata*, sp. n. (Pl. **23**.)

Arbor; rami omnes teretes, glabri, foliorum spiraliter confertorum cicatricibus notati. Gemmæ floriferæ nudæ, depresso-globosæ, bracteis depresso-ovatis brevissime aristato-acutis. Folia ramorum veteriorum spiraliter conferta, adnato-decurrentia, anguste lineari-falcata, incurvo-erecta, acuta, dorso leviter carinata, ramulorum juvenilium longiora, ascendento-patentia, lineari-lanceolata, 15 mm. longa, $2\frac{1}{2}$ mm. lata, ad basin oblique torta, apice obtusiuscula, margine sub lente serrulata, rigida, coriacea, utrinque pagina glaucescentia et striis duabis stomatibus multi-seriatis cincta, octovum in annum virentia, demum exarida sensim soluta. Strobili maturi ovato-globosi, 20 mm. longi, 15 mm. lati; squamæ rotundatæ, mucronatæ, basi distincte unguiculatæ, ungue brevo, lamina dilatata cordata late depresso-ovata, margine integra, lignescentes, sursum coriaceæ et marginem versus subundulatæ, dorso apice leviter carinatæ, glabræ; bracteis obsoletis; squamulæ 3 in medio laminæ, distinctæ, fimbriatæ, crenulatæ. Semina 3, ad squamulorum basin affixa reversa libera, ovato-elliptica, testa coriacea duriuscula, ala angusta cincta; embryo ignotus.

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In conclusion, I must express my hearty thanks to Prof. J. Matsumura under whose special permission this work has been carried out.

EXPLANATION OF THE PLATES.

Plate 22.

PINUS FORMOSANA, Hayata.

Fig. 1. A branch of the plant bearing both young and mature cones. *y*=young cone; *m*=mature cone.
2. A young cone (*y* of fig. 1).
3. A scale of the same, seen from within.
4. The same, seen from without.
5. A cone after dispersing the seeds.
6. A scale, taken from a little below the middle portion of a mature cone (*m* of fig. 1).
7. A scale, taken from the middle portion of the same cone, seen from without.
8. The same, seen from within.
9. A scale, taken from a little above the middle portion of the same cone.
10. A scale.
11. The section of a leaf. *f*=fibro-vascular bundles; *r*=resin-canal.

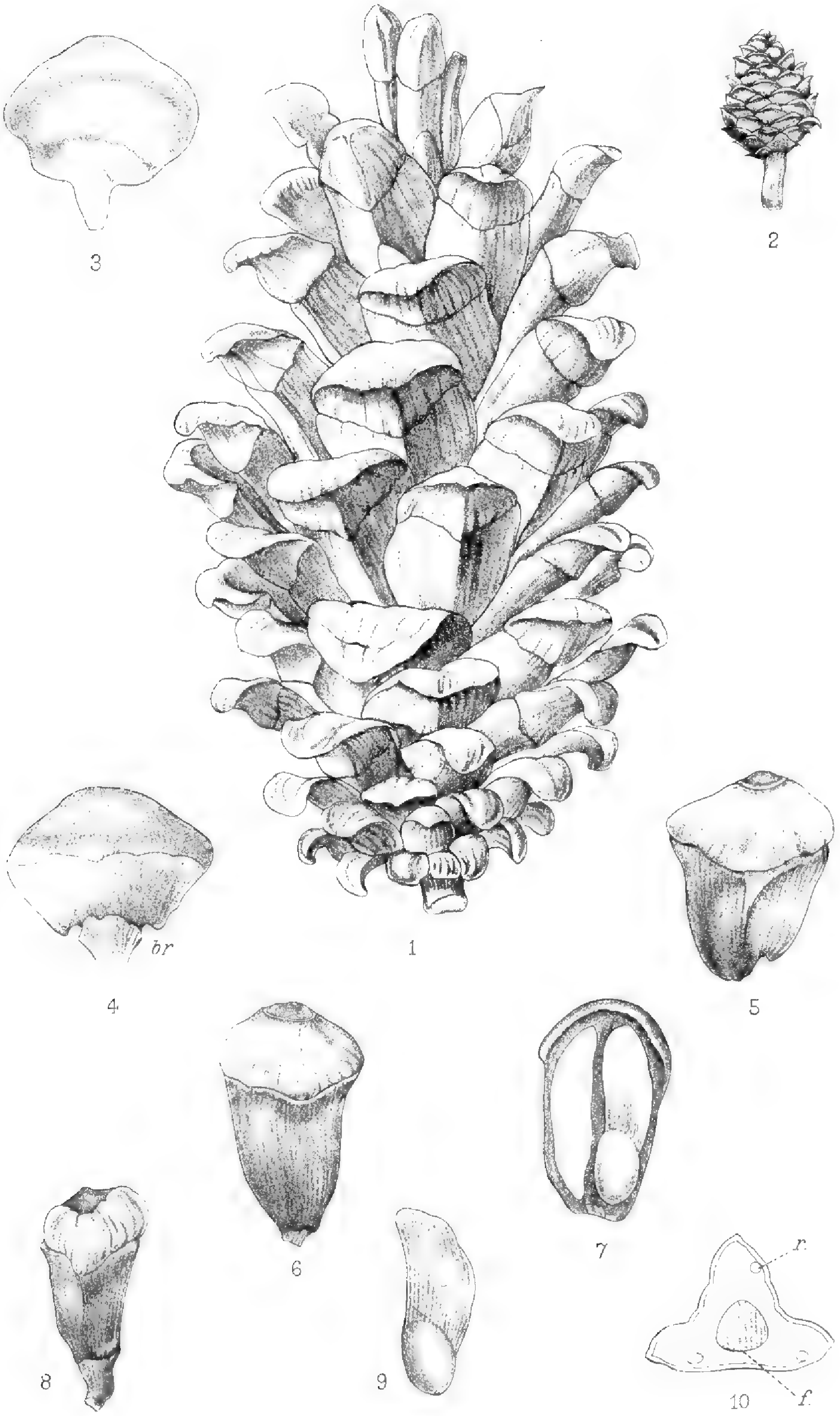
Figs. 1, 2, and 5, natural size; the rest are all more or less magnified.

Plate 23.

CUNNINGHAMIA KONISHII, Hayata.

Fig. 1. A branch, bearing a cone.
2. A leaf (outer or under surface); those portions which bear stomata are shown by dots.
3. A leaf (inner or upper surface).
4. Diagrammatic section of a leaf. *rc*=resin-canal; *Trf*=transfusion tissue; *fvb*=fibro-vascular bundles; *st*=portions of surface with stomata.
5. A scale of the cone (taken from the upper part of the cone; dorsal view).
6. The same (ventral view); traces of seeds are clearly seen.
7. A scale of the cone (taken from middle part of the cone; ventral view); two lateral seeds are clearly seen, the middle one taken off.
8. Seed.
9. The same, seen from the other side.

Fig. 1, natural size; the rest are all more or less magnified.

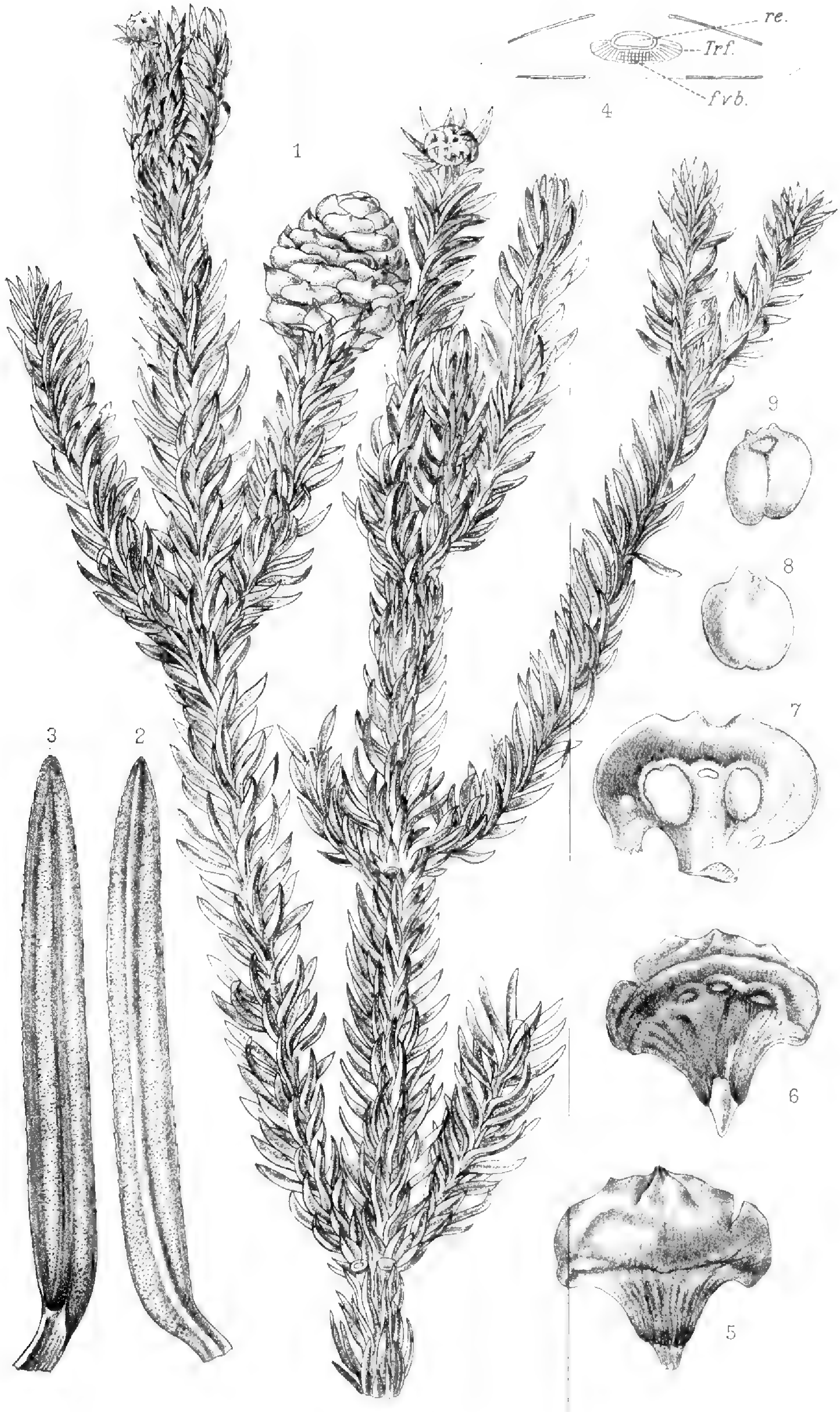


B. Hayata del.
J. N. Fitch lith.

West, Newman imp.

PINUS FORMOSANA, *Hayata*.

Linn. Soc. Journ. Bot. Vol. XXXVIII. Pl. 23.



B. Hayata del.
J. N. Fitch lith.

West, Newman imp.

CUNNINGHAMIA KONISHII, *Hayata*.

On a Collection of Plants made by H. C. Robinson and L. Wray from Gunong Tahan, Pahang. By H. N. Ridley, M.A., F.R.S., F.L.S., assisted by other Botanists.

[Read 5th December, 1907.]

[In 1905 the Trustees of the British Museum made a grant towards the expenses of Mr. H. C. Robinson's expedition to Gunong Tahan in the Malay Peninsula, on condition that the whole collection made by the expedition should be sent to the Natural History Museum and that the first set should become the property of the Trustees. An account of the expedition will shortly be published in the Journal of the Federated Malay States Museum.

The plants, numbering about 250 specimens, were collected from May to July, 1905, by Mr. Robinson and Mr. L. Wray, Director of Museums, Federated Malay States. As Mr. H. N. Ridley, who is specially interested in the botany of the Peninsula, was home on leave during last year, I asked him to prepare an account of the collection. He agreed, but having to return to Singapore early in January, left his paper in an unfinished state; with Mr. E. G. Baker's assistance I have compared it with the specimens in the study set at the British Museum, annotated, and prepared it for the press. The account of the Ferns and Mosses is largely the work of Mr. A. Gepp, and that of the Fungi and Lichens has been prepared by Miss A. Lorrain Smith.

(A. B. Rendle.)]

The mountain Gunong Tahan lies in the north of Pahang, on the east coast of the Malay Peninsula, and was formerly believed to be by far the highest mountain in the Peninsula. It proves, however, to be by no means so lofty as was at first supposed, being only 7100 feet in altitude.

Several attempts were made to explore this mountain on previous occasions. The first of these was undertaken by the author of this paper, accompanied by Mr. W. Davison, Curator of the Raffles Museum, Singapore, and Lieut. Kelsall, R.E., in 1891. The position of the mountain was then unknown, and owing to the limited time allowed, the failure of the commissariat, the extremely unhealthy character of the Tahan Valley, and the unsettled state of Pahang, then on the eve of the rebellion which broke out the following year, the expedition failed to reach its goal. A good collection of plants, however, was made, an account of which was published in the Transactions of this Society, ser. 2, iii. p. 267, and an itinerary of the trip in the Journal of the Royal Asiatic Society, Straits Branch, vol. xxv. p. 33. This expedition attempted to reach the mountain by travelling up the Pahang river, then up the Tembeling and Tahan rivers, which latter stream is reported to spring from the base of the mountain.

In 1893 Mr. H. M. Becher again attempted to reach the mountain by the same route, but perished in a spate of the Tahan river about five miles above the point at which the first expedition stopped. A few plants were added to the collections at Singapore Botanic Gardens by the Gardens' plant-collector, who accompanied Mr. Becher's ill-fated expedition.

In 1899 Mr. W. W. Skeat went with the Cambridge expedition to explore the north of the Peninsula, made a hasty trip to the mountain from the north, and after much difficulty and risk reached it.

In 1901 Mr. John Waterstradt reached the mountain in a trip made chiefly for the purpose of collecting birds. An account of his expedition was published in the Journal of the Royal Asiatic Society, Straits Branch, vol. xxxvii. (1902) pp. 1–27.

The collection of plants made by Messrs. Robinson and Wray is one of considerable interest, and contains a number of remarkable additions to the knowledge of the flora of the Malay Peninsula. It has long been known that the floras of the east and west coasts are very different, the eastern side showing a number of Australian and eastern Asiatic types not met with on the western side, the flora of which is more accessible and has been more thoroughly studied.

The greatest interest centres round the plants, the geographical distribution of which is further extended. Two of these are specially noteworthy, viz. *Pentaphylax malayana*, n. sp., and *Gentiana malayana* : the former is the second representative of a Chinese monotypic genus of Ternstrœmiaceæ previously known only from Hongkong ; the latter is closely allied to a Bornean species occurring on Mt. Kinabalu and to a Javan species.

A curious new genus of Melastomaceæ allied to *Dissochæta*, which I have called *Oritrephes*, is also an important addition. The genus *Xyris* is represented in the Peninsula by several sea-shore species, but is seldom met with inland or at any altitude ; it is absent, so far as is known, from the Perak Hills and Mount Ophir, but one species, *X. Ridleyi*, was found by me on Kedah Peak at about 3000 feet elevation. Two species occur on Gunong Tahan, one identical with that from Kedah Peak, the other, *X. grandis*, n. sp., perhaps the largest species of the genus, conspicuous from its stiff sword-like leaves resembling those of *Cladium Maingayi*, C. B. Clarke, of Mount Ophir.

There are, as usual in such collections, several species of *Didymocarpus*, including two new to science, and a number of Orchids, a good proportion of which are also new.

Among the previously described plants it is interesting to find several of those known only from Father Scortechini's collections and distributed without any specific locality. It is probable that as they have not been met with on the western slopes of the Perak Hills, Scortechini must have collected them on the eastern watershed of the main range. Such are *Gordonia imbricata*, King, *Polyosma coriacea*, King, and *Calophyllum venustum*, King.

SPERMATOPHYTA.

DICOTYLEDONES.

POLYPETALÆ.

DILLENIACEÆ.

ACROTREMA COSTATUM, *Jack, in Mal. Misc.* i.(1820) No. v. 36.

Kwala Teku, 500–1000 ft. (5536.)

Distrib. Common in most hill regions of the Straits Settlements at that altitude and occasionally at lower elevations.

POLYGALACEÆ.

POLYGALA MONTICOLA, n. sp.

Frutex circa bipedalis, basi nuda lignosa, superne haud ramosa. Folia 3–4 poll. longa, 1½ poll. lata, lanceolata utrinque acuminata, petiolata, glabra aut raro pilis translucentibus parce munita, nervis primariis ad 8 paria, petiolo ½ poll. longo. Racemus subterminalis strictus erectus densus. Flores albi, carinis roseis, ¼ poll. longis ; pedicellis brevissimis. Sepala externa ovata rotundata pubescentia. Petala oblonga, carina cristata. Capsula immatura reniformis biloba ferme ¼ poll. in diametro.

Gunong Tahan, 5000–6000 ft. A small shrub ; flowers white ; column edged with yellow, pinkish above ; sepals edged with purple. (5456.) At 4000–5000 ft. ; about 2 feet high. Flower white when first opened, afterwards turning pink ; leaf-stalks tinted pink. (5384).

Forma MAJOR, foliis 6 poll. longis, 2 poll. latis, glabris, petiolis pollicaribus ; racemo 9 poll. longo.

Flowers tipped rose-red, calyx and flower-stalks white ; mid-ribs of leaves tinted with red. At 5000 ft. (5333.)

Though this has been several times collected in the mountains of the Malay Peninsula by different collectors, it seems to have been confused with *P. venenosa*, Juss. Its smaller flowers on very short pedicels, as well as its dwarf stem and dense erect raceme, make it very distinct from the great spreading half-shrub which is common in the lower damp forests ; and it is difficult to see how it could be considered a variety of *P. venenosa*, which is really much less variable than would appear from the number of varieties of it recorded.

PITTOSPOREÆ.

PITTOSPORUM sp. A small tree 10 to 15 feet high, with light-coloured boughs and opposite subcoriaceous lanceolate leaves glabrous with impressed nerves above, strongly reticulate above and beneath, petioles pubescent. Fruit solitary, oval, ¼ inch long, on a slender peduncle 1½ inch long.

Gunong Tahan, 5000–6000 ft. (5444.)

Too incomplete to describe, but I cannot identify it with any Asiatic species. The only species hitherto recorded from the Peninsula is *Pittosporum ferrugineum*, Dryand.

GUTTIFERÆ.

CALOPHYLLUM SPECTABILE, *Willd. in Ges. Naturf. Fr. Berl. Mag.* v. (1811) 80.

In fruit, Gunong Tahan, 3300 ft. A medium-sized tree 50–60 feet high. (5344.)

Distrib. A common and widely dispersed species, occurring from the Andamans eastward to the Society Islands.

C. VENUSTUM, *King, in Journ. As. Soc. Beng.* lix. (1890) 180.

Gunong Tahan, 4000–5000 ft. A small tree with white flowers. (5340, 5395.)

Distrib. Perak. Only once previously collected.

TERNSTRŒMIACEÆ.

ANNESLEA CRASSIPES, *Hook. ex Choisy, in Mém. Soc. Phys. Gen.* xiv. (1855) 129.

Gunong Tahan, 3300 ft. A small tree; calyx bright red. (5322.)

Distrib. Found also on Mt. Ophir, and Gunong Batu Putih and other mountains of Perak; also Philippine Is.

ADINANDRA VILLOSA, *Choisy, l. c.* 112.

Gunong Tahan, 5000–5500 ft. Tree 30–40 ft. high; flowers white. (5517.)

Distrib. Tavoy and Perak at high elevations.

A. ANGULATA, n. sp.

Arbor 40–50-pedalis, ramis compressis, ramulis complanatis angulatis validis, alabastris parce sericeis. Folia elliptica obtuse acuminata coriacea, 4–7 poll. longa, 2–4 poll. lata, siccitate flavescentia, nervis ad 20 paria conspicue reticulatis, petiolo $\frac{1}{2}$ poll. longo crasso. Flores non visi. Bracteæ 2 parvæ ovatæ. Sepala ovata rotundata crassa glabra, $\frac{1}{4}$ poll. longa. Ovarium globosum $\frac{3}{4}$ poll. longum, stylo æquilongo coronatum. Fructus in pedicello 3 poll. longo, superne incrassato.

Gunong Tahan, 5000–5500 ft. (5518.) A very remarkable species, with the foliage of one of the large Garcinias, and quadrate stems with a narrow wing running along each edge. The very large fruits are in pairs.

TERNSTRŒMIA JAPONICA, *Thunb. in Trans. Linn. Soc.* ii. (1794) 335.

Gunong Tahan, 3300 ft. Bush; flowers white; leaves pale green beneath. (5328.)—5000–6000 ft. Shrub 2–3 feet high; flowers greenish white; anthers brown. (5501.)

Distrib. An addition to the flora of the Malay Peninsula. *Ternstrœmia japonica* taken in a large sense is a widely spread species in Eastern Asia, and as *T. aneura*, Miq. (the type of which these specimens closely resemble), occurs in Banka.

GORDONIA IMBRICATA, *King, in Journ. As. Soc. Beng.* lix. (1890) 204.

Gunong Tahan, 6000 ft. A small tree; the flower cream-colour, ¾ inch across. (5436 and 5406.)

Distrib. A rare plant, only collected once in Perak by Scortechini.

SCHIMA NORONHÆ, *Reinw. ex Blume, Bijdr.* 130.

Gunong Tahan, 5000–5500 ft. A small tree 20 to 25 feet high, or a shrub 4–6 feet high; flower white, stamens yellow. (5508, 5525.)

Distrib. Common and variable at high altitudes, occurring also in Burma and the Malay Archipelago.

PENTAPHYLAX MALAYANA, n. sp.

Frutex vel arbor parva, ramis nigris. Folia coriacea glabra ovata obtusa, basi rotundata, nervis inconspicuis, 2 poll. longa, 1 poll. lata, siccitate flavescentia. Spicæ 1 poll. longæ densæ. Bracteæ ovatæ 4, marginibus ciliatis. Sepala ovata rotundata ciliata. Petala linearia oblonga retusa alba. Stamina quam petala breviora, filamentis oblongis, apicibus acuminatis. Stylus cylindricus brevis; stigma planum brevissime 5-lobum. Capsula breviter pedicellata, ¼ poll. longa. Semina linearia curva, 2 in quoque loculo.

Gunong Tahan, 3300–5000 ft. Bush with white flowers. (5325, 5339, 5405.)

A very fine addition to the flora of the Malay Peninsula, the only other known species, *P. euryoides*, Gardn. & Champ., being a native of Hongkong. Specimens of obviously the same species were some years ago brought by Mr. Barnes from K'luang Terbang in Pahang (Journ. Roy. As. Soc., Straits Branch, xxxix. (1903) 1–18). These specimens were in fruit, and the description of the fruit is taken from them. *P. malayana* differs from *P. euryoides* in its smaller, more thickly coriaceous, blunt leaves, and its shorter and thicker flower-spikes.

TILIACEÆ.

ELÆOCARPUS MONTICOLA, n. sp.

Frutex foliis ovato-lanceolatis integris glabris coriaceis, 3 poll. longis, 2 poll. latis, nervorum 6 paribus, petiolis pollicaribus. Racemi breviusculi, 2 poll. longi, foliis breviores. Flores parvi dissiti pedicellati, ¼ poll. longi. Sepala 4 ovata pubescentia roseo-brunnea. Petala vix longiora quam sepala, oblonga, fimbriata, viridescenti-alba, pubescentia. Stamina 12, filamentis brevibus, antheris linearibus, sine barbis seu aristis.

Ovarium globosum, stylo brevius. Torus crassus undulatus. Drupa globosa, plus quam ½ poll. longa, rugosa.

Gunong Tahan, 5000–5500 ft. Shrub 10–12 feet high. Sepals pinkish brown; petals greenish white. (5523.)

Near *Elæocarpus punctatus*, King, in Journ. As. Soc. Beng. lx. II. (1891) 139 (Malay Peninsula, Java, and Sumatra), but differs in the more fimbriate petals, longer style, and entire leaves. The fruit is very different from that of *E. punctatus* and resembles that of *E. parvifolius*, Wall.

RUTACEÆ.

EVODIA SIMPLICIFOLIA, n. sp.

Frutex 7-pedalis ramosus. Folia opposita elliptica obtusa, basi subcuneata vel rotundata, coriacea integra, nervis primariis sæpe 16, nervulis reticulatis, 3–3¾ poll. longa, 1¾ poll. lata, siccitate pallida, petiolis ½ poll. longis. Paniculæ petiolo vix longiores in axillis foliorum summorum dispositæ. Flores non visi. Capsulæ 4-lobatæ ½ poll. latæ rugosæ glabræ.

Gunong Tahan, 5000–6000 ft. A shrub 7 feet high. In fruit. (5492.)

Much resembles *E. pachyphylla*, King, a native of Perak, but is very distinct in its simple unifoliolate leaves and glabrous capsules.

CELASTRACEÆ.

SALACIA PERAKENSIS, *King, in Journ. As. Soc. Beng.* lxv. II. (1896) 364, e descript.

Gunong Tahan, 5000 ft. A small tree; flowers dull red. (5332.) I have seen no authentic specimen.

Distrib. Originally collected in Perak by Scortechini, who gave no exact locality.

ROSACEÆ.

PHOTINIA DUBIA, *Lindl. in Trans. Linn. Soc.* xiii. (1821) 104, t. 10.

Gunong Tahan, 5000–6000 ft. Small shrub 8–15 feet high; fruit brownish red. (5486.)

Not recorded in the 'Flora of the Malayan Peninsula'; it was collected by Griffith at Bukit China, a low hill close to Malacca, and by myself on rocks by the river in the Dindings, where it is a low straggling bush.

Distrib. North India.

PYRUS GRANULOSA, *Bertol. in Mem. Accad. Sc. Bologn.* ser. 2, iv. (1864) 312.

Gunong Tahan, 5000–5500 ft. Tree 15 to 25 feet. (5520.)

Distrib. Khasia, Burma, and Sumatra.

SAXIFRAGACEÆ.

WEINMANNIA BLUMEI, *Planch. in Hook. Lond. Journ. Bot.* vi. (1847) 470.

Gunong Tahan. Tree; flowers red; leaves green, stalks red. (5319.)

Distrib. Higher mountains of the Peninsula.

POLYOSMA CORIACEA, *King, in Journ. As. Soc. Beng.* lxvi. II. (1897) 300.
Gunong Tahan, 4000–5000 ft. Bush; flowers white. (5388.) A small tree 20–30 feet high; flowers yellowish-white. (5493.)
Distrib. Perak and Kedah Peak.

P. LÆTE-VIRENS, *Griff. ex King, l. c.* 303.
Small tree at 5000–6000 ft. (5462.)
Distrib. Malay Peninsula.

HAMAMELIDEÆ.

RHODOLEIA TEYSMANNI, *Miq. in Versl. en Med. K. Akad. Wetensch.* vi. (1857) 123.
Gunong Tahan, 5000–6000 ft. Large shrub 10 feet high, or tree 18 inches in diameter; flower rosy pink. (5482, 5506.)
Distrib. Hill-ranges of Malay Peninsula and in Sumatra.

RHIZOPHOREÆ.

CARALLIA EUGENOIDEA, *King, in Journ. As. Soc. Beng.* lxvi. II. (1897) 320.
Gunong Tahan, 3300 ft. Small tree.
Distrib. Perak. Hitherto only known from Scortechini's collection.

MYRTACEÆ.

BÆCKEA FRUTESCENS, *Linn. Sp. Pl.* 358.
Gunong Tahan, 3300 ft. (5311.)
Distrib. Common on all hills at this elevation; also Malay Archipelago.

LEPTOSPERMUM FLAVESCENS, *Sm.*, var. COMMUNE, *Benth. Fl. Austral.* iii. 104.
Gunong Tahan, 4000–5000 ft., on ridges. Trunk up to 2 feet in diameter, but short and twisted. (5409.)
Distrib. Common on the hills at this elevation in the Malay Peninsula, and throughout the Archipelago to Australia.

RHODAMNIA TRINERVIA, *Blume, Mus. Bot. Lugd.-Bat.* i. 79.
Gunong Tahan, 5000–6000 ft. (5500.) A mountain form with coriaceous ovate acuminate leaves, densely white woolly beneath, less so above, but with silky white pubescence on the upper face and pubescent fruit.
Distrib. Malayan Archipelago and Philippines to Australia; Burma.

EUGENIA PAHANGENSIS, n. sp.
Arbor 20-pedalis cortice albescente. Folia coriacea crassa elliptica petiolata obtusa, costa superne depressa subtus elevata, nervis plurimis gracilibus subparallelis, 3–4 poll. longa, 2 poll. lata. Panicula brevis terminalis densiflora, 2 poll. longa, ramis paucis crassis angulatis. Flores flavescentes parvi congesti sessiles vix ¼ poll. longi. Sepala brevissima crassa,

triangularia acuta. Petala parva caduca orbicularia. Stamina breviuscula. Ovarium obconicum angulatum.

Gunong Tahan, 5000–6000 ft. Small tree 20 feet high; flowers pale yellowish. (5454.)

Belongs to the same group as *Eugenia subdecussata*, Duth., but is very distinct in its foliage.

EUGENIA VIRIDESCENS, n. sp.

Frutex. Folia coriacea sessilia glabra obovata, apicibus late rotundatis vix apiculatis, versus basin angustata, basibus subretusis, $2\frac{1}{2}$–3 poll. longa, $1\frac{1}{2}$ poll. lata, nervis copiosis tenuibus approximatis, costa crassiuscula. Paniculæ quam folia breviores, terminales, 2 poll. longæ, pedunculis brevibus ramulis validulis. Flores inter minores, $\frac{1}{4}$ poll. longa. Calyx campanulatus, margine subintegro undulato. Petala 4 calyptram formantia rotundata. Stamina brevia, calycem paullo superantia.

Gunong Tahan, 5000 ft. A bush; flowers pale green, leaves and young wood tinged with purple. (5338.)

Allied to *E. subdecussata*, Duth., but differs in the form of the leaves, which narrow towards the base and end in a truncate retuse manner. They are less stiff than those of *subdecussata*, drying of a yellowish colour, and the margins curling back. The nervation is very fine and close and hardly distinguishable.

MELASTOMACEÆ.

MELASTOMA MALABATHRICUM, *Linn. Sp. Pl.* 559.

Gunong Tahan, 5000–5500 ft. Flower pinkish. (5514.)

A very large-flowered form of this variable species, the petals being nearly as large as those of *M. decemfidum*, Roxb., but otherwise there is very little difference between this and typical *M. malabathricum* of the plains.

Distrib. India to China and North Australia.

SONERILA HETEROSTEMONA, *Naud. in Ann. Sci. Nat.* sér. 3, xv. (1851) 326.

Kwala Teku, 800–1000 ft. (5538.)

Distrib. Common in the woods of the plains. Malay Peninsula, Sumatra to Borneo.

S. SUFFRUTICOSA, *Stapf & King, in Journ. As. Soc. Beng.* lxix. II. (1900) 29.

Gunong Tahan, 3300 ft. Flowers white or tinted with pink; leaves dull green with white hairs, beneath crimson with white hairs. (5315, 5347.)

Distrib. Perak, Gunong Bubu (previously collected by Wray).

S. PARADOXA, *Naud. l. c.* 321.

Gunong Tahan, 3300 ft. Leaves bright green with metallic blue lights, beneath crimson, hairs on both sides crimson; flowers pale pink. (5362.) The very hairy form common at higher elevations.

Distrib. Penang.

ANERINCLEISTUS FRUTICOSUS, n. sp.

Suffrutex multi-ramosus, cortice fusco. Folia subcoriacea lanceolata acuminata glabra, 1–3 poll. longa ½ poll. lata, subtus glauca, apicibus obtusis, basibus acuminatis. Flores solitarii vel 3–4 umbellati, pedunculo ½ poll. longo. Calycis tubus vix dilatus glaber. Sepala subulata acuminata glabra, ¼ poll. longa. Petala 4, rosea lanceolata acuminata ferme subulata. Stamina 8, antheris elongatis ¼ poll. longis inæqualibus, basi obscure emarginatis, nec appendiculatis, antheris sterilibus rubris. Capsula obconica ⅜ poll. longa ¼ poll. lata.

Gunong Tahan, 5000–6000 ft. Small shrub; flower pale pink; anthers pale yellow. (5453.)

Allied to *A. macranthus*, King, but more glabrous with smaller leaves and more woody.

ORITREPHES, n. gen.

Frutex; foliis oppositis ellipticis acuminatis, basi cuneatis, trinerviis. Panicula terminalis pauciflora, floribus majusculis. Calyx leprosus obconicus, apice constricto, lobis 4 brevibus connatis, dentiformibus. Petala 4 obovata unguiculata alba. Stamina 8, æqualia, similia, antheris elongatis versus apices attenuatis, poro terminali, basibus breviter hastatis, appendicibus et setis nullis, dorso processu parvo circulari onustis. Stylus longus, stigmate punctiformi. Ovarium 4-loculatum ellipticum, ferme ad basin tubi calycis liberum, vertice depresso-concavum. Fructus baccatus. Semina plura, placentis axillaribus suffulta; adhuc immatura.

O. PULCHRA, n. sp.

Frutex ramosus; foliis superne glabris inferne rufescenti-lepidotis, nervis tomento rufo tectis, primariis tribus subtus elevatis, secundariis horizontalibus circa 26 paribus, 2–5 poll. longis, 1–2 poll. latis, petiolo pollicari. Pedunculus 3 poll. erectus, glaber. Flores 4–6. Calyx in pedicello æquilongo, ¼ poll. longus, lobis brevibus connatis. Petala obovata retusa unguiculata, alba roseo-tincta. Stamina petalis æquilonga, filamentis pubescentibus, antheris flavis. Fructus leprosus immaturus ½ poll. longus.

Gunong Tahan, 5000–5500 ft. Petals white tipped with pink. (5509.)

Closely allied to *Dissochæta* and *Anplectrum*. Remarkabie for its 8 similar stamens without hairs or appendages.

MEDINILLA CLARKEI, *King, in Journ. As. Soc. Beng.* lxix. II. (1900) 63.

Gunong Tahan, 3300 ft. Small-sized tree. (5312.)

Distrib. Malay Peninsula.

MEDINILLA PAHANGENSIS, n. sp.

Frutex epiphyticus, cortice albo verrucoso. Folia verticillata lanceolata subobtusa vel oblanceolata, basi angustata, coriacea enervia, 2 poll. longa $\frac{3}{4}$ poll. lata, petiolo $\frac{1}{4}$ poll. Flores in cymis 1 poll. longis, pentameri, albi, $\frac{1}{2}$ poll. longi. Calyx cupuliformis, granulatus, obscure 5-dentatus. Petala obovata rotundata. Stamina 10, filamentis sinuatis glabris, antheris æquilongis curvis, processibus 2 anticis ad basin corniformibus, unoque dorsali.

Gunong Tahan, 4000–5000 ft. Growing on trees; flowers white. (5396.)

In general appearance resembles *M. Hasseltii*, Blume, but is pentamerous.

PACHYCENTRIA TUBERCULATA, *Korth. Ver. Nat. Gesch. Bot.* 246, t. 63.

Gunong Tahan, on trees at 3300 ft. Flowers white, each petal tinted rose-red at the base; flower-stalks, fruit, and mid-ribs of leaves beneath coral-red. (5237.)

Distrib. Malay Peninsula, Burma, Borneo. Common at all altitudes.

MEMECYLON GARCINIOIDES, *Blume, Mus. Bot. Lugd.-Bat.* i. 358.

Gunong Tahan, 3300 ft. Flowers white; anthers violet. (5352.)

Distrib. Borneo and Sumatra.

M. MAINGAYI, *C. B. Clarke, in Hook. fil. Fl. Brit. Ind.* ii. 557.

Gunong Tahan, 5000–6000 ft. Creeper; fruit chrome-yellow. (5457.)

Distrib. Malay Peninsula.

BEGONIACEÆ.

BEGONIA SINUATA, *Wall. List*, n. 3680.

Kwala Teku, 500–1000 ft. Flowers pale pink; stamens chrome-yellow; stalks purplish pink, leaves beneath reddish purple. (5539.)

Distrib. Burma, Malay Peninsula.

B. HERVEYANA, *King, in Journ. As. Soc. Beng.* lxxi. II. (1902) 63.

Kwala Teku, 500–1000 ft. (5546.)

Distrib. Malacca.

GAMOPETALÆ.

RUBIACEÆ.

ARGOSTEMMA MUSCICOLA, n. sp.

Herba parva erecta vel suberecta, hispidula, 2 poll. alta. Folia æqualia anguste lanceolata acuta basi cuneata herbacea, glabra, nervis tribus et marginali pilis albescentibus munitis exceptis, 1–1$\frac{1}{2}$ poll. longa, $\frac{1}{2}$ poll. lata; petiolo brevi. Flores 1–2 terminales pedunculati, albi, inter majores generis, $\frac{1}{2}$ poll. lati. Bracteæ lanceolatæ, et cum pedicellis hirsutæ. Sepala lanceolata acuta. Petala lanceolata acuta.

Gunong Tahan, 5000–6000 ft. Small herb on mossy rocks by streams. (5461.)

The number of Argostemmas in the Peninsula is large and increases with every mountain explored, as in the case of *Sonerila*. This little erect species belongs to the set with equal leaves, but has somewhat the habit of *A. involucratum*, Hemsl.

ARGOSTEMMA ALBOCILIATUM, n. sp.

Herba reptans, gracilis, hispida, 3–7 poll. longa. Folia æqualia ovata apicibus subacutis vel rotundatis, breviter petiolata, dense hispida, $\frac{1}{2}$ ad poll. longa, $\frac{1}{4}$–$\frac{1}{2}$ poll. lata. Stipulæ breves ovatæ. Flores 1–4 in pedunculo gracili hispido, 2 poll. longo. Bracteæ minutæ lanceolatæ lineares. Calyx hispidus, lobis brevibus hispidis. Petala lanceolata acuminata, hispidula, $\frac{1}{4}$ poll. longa.

Gunong Tahan, 3300 ft. Flowers white ; leaves pale green, covered with white hairs. (5229.)

A curious creeping species with ovate hairy leaves.

A. YAPPII, *King, in Journ. As. Soc. Beng.* lxxii. II. (1903) 145.

Gunong Tahan, 5000–6000 ft. Flowers white ; anthers yellow. (5491.)

Distrib. Perak.

A. HOOKERI, *King, l. c.* 45.

Gunong Tahan, 3300 ft. Leaves dark green, with broad irregular stripe of light silvery green in centre. (5376.)

Distrib. Malay Peninsula. Frequent on the hills.

A. PICTUM, *Wall. in Roxb. Fl. Ind. ed. Carey & Wall.* ii. 327.

Kwala Teku, 500–1000 ft. Flowers white. (5543.)

Distrib. Malay Peninsula. Common in hill-forests.

OPHIORRHIZA MUNGOS, *Linn. Sp. Pl.* 150.

Kwala Teku, 500–1000 ft. (5534.)

Distrib. India, Malaya. A variable species common all over the Peninsula.

HEDYOTIS PATENS, n. sp.

Frutex parvus subrepens ramosus. Folia lanceolata carnosula acuta æqualia, basibus cuneatis, glabra, 2–3 poll. longa, $\frac{1}{2}$–$\frac{3}{4}$ poll. lata. Stipulæ late triangulares carnosæ acutæ persistentes. Panicula laxa patens, 6–8 poll. longa, sæpe 6 poll. lata, ramis trichotomis patentibus trifurcatis, gracilibus. Flores parvi singuli pedicellati in apicibus ramulorum. Calyx obconicus, lobis triangularibus acutis. Petala linearia alba. Stamina gracilia longe porrecta corollam multo superantia. Stylus longus porrectus. Capsula obovoidea, $\frac{1}{12}$ poll. longa.

Gunong Tahan, 4000–5000 ft. Bush; flowers pale green. (5393.) At 5000–6000 ft. Shrub somewhat creeping in habit; flowers greenish. (5475.)

Allied to *Hedyotis Maingayi*, Hook. fil., of Mount Ophir, and *H. peduncularis*, King, of Kedah Peak, but much more branched than either. This group of *Hedyotis* is very characteristic of our high elevations, and the species are usually confined to one mountain-top.

Timonius montanus, n. sp.

Frutex 8-pedalis. Folia elliptica vel elliptico-lanceolata acuminata basi cuneata, glabra, 2½–3 poll. longa, 1–1½ poll. lata, nervis circa 6 paribus, in pagina inferiore conspicuis, breviter petiolata. Stipulæ lanceolatæ acuminatæ. Flores 2–3 in pedunculo brevi vix ¼ poll. longo, sessiles, glabri, flavi. Calyx campanulatus pubescens, lobis acutis triangularibus. Corollæ tubus longus cylindricus glaber, ½ poll. longus, lobis oblongis obtusis. Stamina inclusa, antheris linearibus. Flores fœminei et fructus non visi.

Gunong Tahan, 5000–6000 ft. Shrub 8 feet high; petals pale yellow; anthers rich chrome-yellow; corolla-tube reddish externally. (5499.)

Resembling in habit some forms of *T. jambosella*, Thw., but distinguished by its long glabrous corolla and short peduncle.

Lasianthus chinensis, *Benth. Fl. Hongk.* 160.

Gunong Tahan, 5000–5500 ft. Shrub 10–11 ft.; fruit brownish. (5524.)

Distrib. Perak, Hongkong, Formosa.

L. coronatus, *King & Gamble, in Journ. As. Soc. Beng.* lxxiii. ii. (1904) 120.

Gunong Tahan, 5000–6000 ft. Shrub; flowers white. (5503, 5438.)

Distrib. Perak.

CAMPANULACEÆ.

Pentaphragma grandis, n. sp.

Herba 1–2-pedalis, caule fistuloso, ¼ poll. crasso. Folia alterna remota elliptica obovata obtusa denticulata, basi inæquilatera, superne glabra, 5 poll. longa, 2¾ poll. lata, subtus præcipue in venis pilosula deinde glabrescentia, petiolo 1 poll. longo. Flores 6–7 axillares, aggregati, ¾ poll. longi, sordide albi. Bracteæ ovarium subæquantes, scariosæ, caducæ. Calyx tubulosus, lobis lanceolatis oblongis obtusis, omnino lanuginoso-pubescens. Petala sepalis subæqualia, apicibus recurvis pubescentibus. Stamina linearia. Stylus validus, basi pubescens; stigma cylindricum crassum canaliculatum.

Gunong Tahan, 4000–5000 ft. 1–2 feet high; flowers dirty white; leaves bright green fleshy, pale beneath. (5408.)

A large plant for the genus, remarkable for its tall fistular stem and large flowers.

VACCINIACEÆ.

VACCINIUM PUBICARPUM, n. sp.

Frutex 4-pedalis terrestris. Folia tenuiter coriacea lanceolata acuminata acuta glabra obscure serrulata, 2 poll. longa, $\frac{3}{4}$ poll. lata, nervis primariis 6, petiolo $\frac{1}{5}$ poll. longo. Racemi foliis breviores 2 poll. longi laxi. Bracteæ minutæ lineares. Flores pedicellati, pedicellis $\frac{1}{4}$ poll. longis, cum calyce pubescentibus. Calyx cupulatus, lobis acutis triangularibus. Corolla omnino pubescens. Staminum filamentis brevibus, antheris linearibus oblongis, processibus 2 apicalibus rectis cylindricis, antheras æquantibus, omnino glabra. Stylus cylindricus crassiusculus, apice plano. Bacca parva globosa pubescens sepalis coronata, $\frac{1}{4}$ poll. longa.

Gunong Tahan, 5000–6000 ft. Shrub 4 feet high, in shady ravines. (5443.)

Resembles *V. malaccensis*, Wight, which is common in the lowlands of the Peninsula, but differs in the long acuminate leaves and pubescent fruit.

V. LONGIBRACTEATUM, n. sp.

Frutex ramis fuscis hirtis, pilis albis. Folia alterna ovata subcordata obtusa coriacea inferne pubescentia superne glabra, 1–1$\frac{1}{2}$ poll. longa, $\frac{3}{4}$–1$\frac{1}{4}$ poll. lata, petiolis pubescentibus $\frac{1}{5}$ poll. longis. Racemi terminales longiusculi, rhachidibus pubescentibus. Bracteæ foliaceæ coriaceæ lanceolatæ acutæ pubescentes, flores multo superantes, $\frac{1}{2}$–1 poll. longæ, $\frac{1}{4}$ poll. latæ. Flores desunt. Baccæ $\frac{1}{5}$ poll. longæ globosæ pubescentes, pedicellis $\frac{1}{4}$ poll. longis pubescentibus ; lobis calycis triangularibus acutis 5, inflexis.

Gunong Tahan, 3300 ft. (5326.)

Remarkable for its pubescence and the large lanceolate bracts. The leaves are close-set and very coriaceous, hairy beneath with conspicuous ascending nerves.

V. TEYSMANNI, *Miq. Fl. Ind. Bat.* ii. 1062.

Gunong Tahan. 3300 ft. Flowers crimson ; leaves rusty beneath. (5053.)

Distrib. Perak ; Java.

ERICACEÆ.

PIERIS OVALIFOLIA, *D. Don, in Edinb. Phil. Journ.* xvii. (1834) 159.

Gunong Tahan, 5000–6000 ft. Small tree 15–20 feet ; flowers whitish. (5476.)

Distrib. Himalayas to Japan.

RHODODENDRON MALAYANUM, *Jack, in Mal. Misc.* ii. (1822) no. VII. 17.

Gunong Tahan, 3300 ft. Small tree. (5323.)

Distrib. Common on hills in Malay Peninsula ; Malaya.

RHODODENDRON WRAYI, *King & Gamble, in Journ. As. Soc. Beng.* lxxiv. II. (1906) 75.

Gunong Tahan, 4000–5000 ft. (5387.)

Distrib. Occurs also in the Kedah, Selangor, and Perak hills.

R. LONGIFLORUM, *Lindl. in Journ. Hort. Soc.* iii. (1848) 88.

Gunong Tahan, 4000–5000 ft. Growing on trees; flowers salmon-pink. (5382.)

Distrib. Perak, Borneo, and Sumatra.

R. ELEGANS, n. sp.

Epiphytica, ramis tenuibus undulatis. Folia opposita vel 5-verticillata elliptico-lanceolata obtusa basi cuneata parva, coriacea, glabra, $\frac{3}{4}$–1 poll. longa, $\frac{1}{2}$ poll. lata, nervis inconspicuis, subtus crebre punctata superne nitida, petiolis brevissimis $\frac{1}{10}$ poll. longis. Flores rubri singuli terminales, $\frac{1}{2}$ poll. longi, $\frac{2}{5}$ poll. lati, pedicellis æquilongis pubescentibus gracilibus. Calyx cupularis parvus, lobis brevissimis ovatis. Corolla parva recta crassa cylindrica rubra pubescens, lobis rotundatis brevibus. Stamina 8, filamentis pubescentibus. Ovarium hirtum. Stylus cylindricus crassiusculus haud exsertus; stigma clavatum.

Gunong Tahan, 5000 ft. Flowers bright red; leaves dark shining green; growing on trees. (5429.)

A very elegant little slender-branched plant with small flowers. I know nothing exactly like it.

EPACRIDEÆ.

LEUCOPOGON MALAYANUS, *Jack, in Mal. Misc.* i. (1820) no. v. 20.

Gunong Tahan. Small tree. (5316.)

Distrib. Common on all the hills and on sandy coasts of the Peninsula. Occurs also in Borneo and Banka, with a variety in Tenasserim.

MYRSINEÆ.

ARDISIA ROSEA, *King & Gamble, in Journ. As. Soc. Beng.* lxxiv. II. Extr. (1906) 150.

Gunong Tahan, 5000–6000 ft. Small tree; flowers white, stalks purplish. (5467.) Shrub; flowers white, flower-stalks red; leaves and young wood tinged with red. (5334.)

Distrib. Perak, on most hill-ranges at high elevations.

A. BINIFLORA, n. sp.

Frutex validus, ramis pallidis densis. Folia coriacea lanceolata obtusa basibus cuneatis, glabra, $2\frac{1}{2}$ poll. longa, 1 poll. lata, carina subtus crassiuscula, nervis copiosis, petiolo $\frac{1}{4}$ poll. longo. Flores axillares bini vel terni in pedunculo 1 poll. gracili, foliis breviores. Bracteæ ad basin pedunculi et pedicellorum foliaceæ parvæ ovatæ. Sepala rotundata brevia

haud imbricata marginibus glanduloso-dentatis. Petala lanceolata acuta, glandulosa, glandulis magnis, ¼ poll. longa. Antheræ lanceolatæ apiculatæ.

Gunong Tahan, in ravines, 5000–6000 ft. Shrub 10–15 feet high; flower reddish pink; anthers brownish. (5460.)

A shrub with the habit of *Ardisia littoralis*, Andr., but with very stiff, closely-veined, entire, obscurely gland-dotted leaves, and flowers in pairs on axillary peduncles.

Ardisia retinervia, n. sp.

Frutex 10–12 ped. alt., ramis validis brunneis, omnino glaber. Folia coriacea elliptica, apice rotundata, basi cuneata, 4–4½ poll. longa, 2 poll. lata, crebre glanduloso-punctata in utraque pagina, costa superne depressa subtus elevata crassiuscula; nervis superne inconspicuis, subtus elevatis horizontalibus numerosis valde reticulatis usque ad margines; margines integri, glandulis marginalibus nullis; petiolo valido brevi, ½–1 poll. longo. Cymæ pauciflore axillares breves. Flores desunt; pedicelli fructiferi subangulati, ½ poll. longi. Sepala 5 ovata obtusa haud glandulifera glabra brevia. Drupa globosa multi-sulcata, ¼ poll. longa; stylo brevi.

Gunong Tahan, 5000–6000 ft. Shrub 10–15 feet high. (5502.)

Remarkable chiefly for its stiffly coriaceous, strongly reticulated leaves. The drupe, which is large for the genus, is marked with narrow ridges and grooves.

STYRACEÆ.

Symplocos adenophylla, *Wall. ex G. Don, Gen. Syst.* iv 3

Gunong Tahan, 3300 ft. (5320.)

Distrib. Malay Peninsula and Archipelago.

S. Scortechinii, *King & Gamble, in Journ. As. Soc. Beng.* lxxiv. II. extr. (1906) 250.

Gunong Tahan, 4000–5000 ft. Tree; flowers white, tinged near the ends of the petals with pink, veins of flowers red. (5392.)

Distrib. Perak. I have seen no authentic specimen of this plant, which has only once been collected, by Scortechini.

ASCLEPIADACEÆ.

Pentasacme caudatum, *Wall. in Wight, Contrib.* 60.

Kwala Teku, 500–1000 ft. (5533.)

Distrib. Common in streams at high altitudes in the eastern side of the Peninsula; North India, Burma.

Dischidia coccinea, *Griff. Notulæ*, iv. 45.

Gunong Tahan, 3300 ft. On trees; flowers red; leaves dull crimson. (5410.)

Distrib. Malay Peninsula; common at high altitudes.

DISCHIDIA ALBIDA, *Griff. Notulæ*, iv. 46.
Gunong Tahan. On trees ; flowers pale yellow. (5399.)
Distrib. Malay Peninsula.

GENTIANACEÆ.

GENTIANA MALAYANA, n. sp.

Herba pusilla 1–3 poll. alt. Folia carnosa congesta acuta lanceolata sessilia integra glabra, $\frac{1}{4}$–$\frac{1}{2}$ poll. longa. Flos terminalis $\frac{1}{3}$ poll. longus. Calyx tubulosus, lobis acuminatis tubum corollæ superantibus. Corolla azurea tubulosa, lobis brevibus subspathulatis apicibus rotundatis, plicis integris. Stamina antheris longius hastatis prædita. Ovarium stipitatum ; stylo brevi, stigmatibus brevibus.

Gunong Tahan, 5000–6000 ft. Flowers deep sky-blue. Growing among moss in damp places (5473) ; on wet rocks (5479).

The addition of the genus *Gentiana* to the Flora of the Malay Peninsula is an interesting one. The species is closely allied to *G. borneensis*, Hook. fil., from Kinabalu, differing chiefly in the quite entire leaves, rounded tips of the petals and entire, not lobed, folds between them. The anthers are narrower and more acute.

The plants collected under the two numbers seem specifically identical, but the specimens of no. 5473 are very much smaller than those of 5479.

CANSCORA TRINERVIA, n. sp.

Herba 3–5 poll. alta, caulibus pluribus. Folia glabra ovata vel ovato-lanceolata herbacea utrinque acuminata trinervia, $\frac{1}{2}$–1 poll. longa, $\frac{1}{2}$–$\frac{3}{4}$ poll. lata. Flores in axillis superioribus, albis. Calyx tubulosus superne angustatus $\frac{1}{2}$ poll. longus, costis 8 elevatis, alternis bifurcatis, lobis acuminatis. Corolla irregularis alba, tubo quam sepala paullo longiore, lobis 4 oblongis rotundatis marginibus crispis, uno multo latiore, $\frac{1}{4}$ poll. longis. Stamina fertilia 3, antheris oblongis, uno sterili filiformi. Stylus sat longus ; stigmatibus 2 linearibus elongatis.

Gunong Tahan, 5000–5500 ft. Herb by stream ; flowers white. (5507.)

There are two species of this genus recorded by C. B. Clarke in his description of the family in the "Materials for a Flora of the Malayan Peninsula," one of which, *C. diffusa*, a common Indian species, is recorded as belonging to this region only on the authority of a specimen collected by Lobb in Singapore and undoubtedly wrongly localised. The other, *C. pentanthera*, C. B. Clarke, an endemic species, occurs usually at high elevations ; it has five complete stamens and a regular corolla, while *C. trinervia* has three complete stamens only and a staminode and an irregular corolla.

macula flava in ore tubi notata, $\frac{3}{4}$ poll. longa. Capsula gracilis cylindrica acuminata, $2\frac{1}{2}$ poll. longa.

Gunong Tahan, 5000–6000 ft. Flowers purplish streaked with white, with yellow at top of tube. (5470.)

This species is allied to *D. hispida*, Ridl. It is unusually branched and woody for its group.

LOXOCARPUS INCANA, *R. Br. in Benn. Pl. Jav. Rar.* 120.

Gunong Tahan, 5000 ft. Flowers pale violet, darker in the throat. (5430.)

Distrib. Malay Peninsula.

L. ANGUSTIFOLIA, n. sp.

Herba acaulis, foliis lanceolatis acutis subfalcatis plurimis, basibus in petiolis attenuatis sericeis, $\frac{3}{4}$–2 poll. longis, $\frac{1}{4}$–$\frac{1}{2}$ poll. latis. Pedunculus tenuis erectus sericeus, 2 poll. longus. Flores 2–3. Sepala lanceolata hispido-sericea, $\frac{1}{12}$ poll. longa. Corollæ $\frac{5}{12}$ poll. longæ, tubus crassus brevis, lobi rotundati, labium inferius longius, pallide purpureum. Capsula cornuta curva acuminata, pilis viscidis tecta.

Gunong Tahan, 5000–6000 ft. (5504.)

A very distinct plant with narrow lanceolate oblique leaves.

PARABŒA PYROLIFLORA, *Ridl. in Journ. Roy. As. Soc. Straits Br.* no. xliv. (1905) 67.

Kwala Teku, 300–1000 ft. (5545.)

Distrib. Originally found in the Tahan valley.

P. RUBIGINOSA, n. sp.

Radix crassa lignosa, 6 poll. longa; caudex brevis, 1 poll. longus, lignosus, tomento multo rufo tectus vel nullus. Folia rosulata vel opposita oblanceolata obtusa basin versus angustata rotundata, margine dentato, nervis 10 paribus, superne atroviridia hispida, præsertim in marginibus, subtus crebre punctata glabra, nervis et costa rubiginoso-tomentosis exceptis. Pedunculi 3 vel plures, graciles, 6–8 poll. longi, rubro-pubescentes. Bracteæ minutæ lineares pubescentes. Sepala linearia brevia, vix $\frac{1}{12}$ poll. longa. Corolla alba colore roseo tincta campanulata, $\frac{1}{4}$ poll. longa, lobis rotundatis. Stamina brevia 2, antheris subglobosis. Capsula lanceolata acuminata, $\frac{3}{4}$ poll. longa.

Gunong Tahan, 4000–5000 ft.; on rocks. Leaves dark velvety green; flowers white tinged with pink. (5398.)

Flowers resembling those of *P. pyroliflora*, Ridl., but the style is much shorter. The foliage is very different and more resembles that of *Didymocarpus heterophylla*, Ridl.

CYRTANDRA CUPULATA, *Ridl. in Journ. Linn. Soc., Bot.* xxxii. (1896) 527.

Kwala Teku, 500–1000 ft. (5540.)

Distrib. Malay Peninsula.

ÆSCHYNANTHUS sp.

Gunong Tahan, 5000–6000 ft. Creeper very fleshy, reddish. (5483.)

A rather woody plant with pale bark and oval fleshy leaves $\frac{1}{2}$ an inch long. There are no flowers (only pods already dehisced) and no seed. Doubtless an undescribed species, but the material is insufficient.

APETALÆ.

NEPENTHACEÆ.

NEPENTHES BONGSO, *Korth. Verh. Nat. Gesch. Bot.* 19, t. 14.

Gunong Tahan, 5000 ft. Flowers dull red-brown; cups white tinted pale green at base and spotted with pink. (5411.)

The original plant was obtained on Merapi mountain in Sumatra. The Tahan plant seems to resemble it very closely, but the fruit is much larger than it is in Korthals's figure. The male flowers are small, with 4 oblong obtuse pubescent petals $\frac{1}{10}$ inch long, the pedicels of the flowers $\frac{1}{4}$ inch. The raceme is lax and about 6 inches long. The lid of the pitcher is densely glandular. The capsules are three-quarters of an inch long.

N. GRACILLIMA, n. sp.

Caulis gracillimus $\frac{1}{10}$ poll. in diametro. Folia remota sessilia anguste lanceolata acuminata, lamina 2–3 poll. longa $\frac{1}{2}$ poll. lata glabra coriacea; petiolulo 5-pollicari; amphora subcylindrica angusta, 4 poll. longa, $\frac{3}{4}$ poll. in diametro, superne glandulosa paullo constricta, annulo angusto, obscure costato. Operculum orbiculare $\frac{1}{2}$–$\frac{3}{4}$ poll. longum, cervice et lamina pubescentibus, cornibus ad basin operculi duobus $\frac{1}{10}$ poll. longis, glandulæ nullæ. Racemus masculus gracilis plus quam 6 poll. longus. Flores parvi dissiti, pedicellis $\frac{1}{10}$ poll. longis. Bracteæ lineares graciles. Petala 4 oblonga obtusa glabra. Racemus fructiferus circa 6 poll. longus; capsulæ $\frac{3}{4}$ poll. longæ glabræ, pedicellis $\frac{1}{2}$ poll. longis, valvæ utrinque angustatæ.

Gunong Tahan, 3300 ft. Pitchers pale green, tinted in places with dull crimson, and mottled with dull purple; lid of cup brighter green lined with dull crimson. (5309.)

Allied to *N. gracilis*, Korth., but is a much slenderer plant; the stem is rounded and not angular, the leaves are not decurrent, the peristome is faintly ribbed on the lower surface, the cup is differently coloured, and the lid is not glandular.

LAURACEÆ.

DEHAASIA LANCIFOLIA, n. sp.

Arbor 25-pedalis. Folia coriacea lanceolata obtusa (siccitate rufa),

breviter petiolata glabra, nervorum 9–11 paribus prædita; nervis ascendentibus in margine arcuatis, costa crassiuscula, $4\frac{1}{2}$–$7\frac{1}{2}$ poll. longa, $1\frac{1}{2}$–2 lata. Paniculæ elongatæ patentes 7–8 poll. longæ, ramulis paucis brevibus pubescentibus. Flores 6–7 perparvi in cymulas in apicibus ramulorum virescentes dispositi, pedicellis brevibus pubescentibus. Sepala 3 minuta ovata obtusa. Petala alterna ovata obtusa cucullata pubescentia, quam sepala multo majora. Stamina 9 filamentis brevissimis, antheris ovatis. Stylus quam stamina longior crassus; stigma magnum rotundatum crassum atrum. Drupa elliptica $1\frac{1}{2}$ poll. longa, pedunculo haud multum incrassato.

Gunong Tahan, 5000–6000 ft. Tree 11 inches in diameter, 25 feet high, flowers greenish (5468). Shrub 8–10 feet, in fruit (5526).

This fine plant is represented by two specimens, one in flower and one in fruit, which evidently belong to the same species. The leaves are bright brown when dry. The main nerves ascend and curving upwards at the margin connect with each other by a loop, and the intermediate nervules are conspicuously reticulated. The long lax panicle of short branches is not like that of any other species known to me. The flowers are quite those of a *Dehaasia*, some unisexual and some bisexual. The stigma is remarkably thick and rounded for the genus.

LINDERA CÆSIA, *Reinw. ex Vill. in Blanco, Fl. Philipp.* ed. 3, *Nov. App.* 181, e descript.

Gunong Tahan, 5000–6000 ft. Small shrub. (5455.)

Distrib. Philippines to Borneo.

LORANTHACEÆ.

LORANTHUS PULCHER, *DC. Prod.* iv. 295.

Gunong Tahan, 5500 ft. Shrub; flowers carmine; calyx and flower-stalks dull red; leaves very thick and fleshy. (5337.) The leaves are more oval in outline and more fleshy than usual. Not rare in the hill-region.

Distrib. Penang.

L. LOBBII, *Hook fil. Fl. Brit. Ind.* v. 204.

Gunong Tahan. (5485.) Common in the hill-regions.

Distrib. Penang.

L. GLOBOSUS, *Roxb. Fl. Ind.* i. 550.

Gunong Tahan, 4000–5000 ft.; on trees. Flowers bright orange-red, leave red above and dull green beneath. (5404.)

Distrib. North India, Malay Peninsula, Java.

SANTALACEÆ.

HENSLOWIA VARIANS, *Blume, Mus. Bot. Lugd.-Bat.* i. 244.
Gunong Tahan, 3300 ft. Climber; fruit green, tinted dull red. (5349.)
Distrib. Tenasserim, Malacca, Borneo.

H. LOBBIANA, *A. DC. Prod.* xiv. 631.
Gunong Tahan, 5000–6000 ft. Creeper; berries reddish. (5484.)
Distrib. Malay Peninsula.

EUPHORBIACEÆ.

CHORIOPHYLLUM MONTANUM, n. sp.
Frutex ramosus, foliis oppositis coriaceis, ellipticis, basibus angustatis, apicibus retusis, superne nitidis, subtus pallidioribus 2 poll. longis, $\frac{3}{4}$ poll. latis, breviter petiolatis, petiolo $\frac{1}{10}$ poll. longo. Flores non visi. Capsula tricocca globosa, coccis bivalvibus $\frac{1}{2}$ poll. longis. Semina $\frac{1}{4}$ poll. longa rufo-castanea polita elliptica subobliqua, arillo bilobo, semen semitegente, lobis subacutis triangularibus.
Gunong Tahan, 3300 ft. (5434.) Flowers yellow.
Very distinct from *Ch. malayanum*, Benth., in its much smaller, elliptic, very coriaceous leaves.

MYRICACEÆ.

MYRICA FARQUHARIANA, *Wall. Tent.* 61.
Gunong Tahan, 5000–5500 ft. Shrub 10–12 feet high; flowers reddish-brown. (5519.)
Distrib. India, Malaya.
Common in the low country near the sea. This is referred to *M. Nagi*, Thunb., in the 'Flora of British India,' v. 597, but I cannot think it is identical with that Japanese plant.

CUPULIFERÆ.

QUERCUS RASSA, *Miq. Fl. Ind. Bat. Suppl.* 350.
Gunong Tahan, 6000 ft. (5440.) One of the very few oaks which are to be met with at an elevation of over 3000 ft.
Distrib. Malay Peninsula and Archipelago.

MONOCOTYLEDONES.

ORCHIDEÆ.

OBERONIA (§ Caulescentes) CONDENSATA, n. sp.
Caules congesti, 1–2 poll. longi, radicibus densis tenuibus ad bases præditi. Folia carnosa decidua linearia acuta, $\frac{3}{4}$ poll. longa, $\frac{1}{8}$ poll. lata. Racemus pollicaris ad basin florifer. Bracteæ lanceolatæ longe acuminatæ, ad

racemi basin longiores, superne minores. Flores citrini, $\frac{1}{12}$ poll. in diametro. Sepala ovata obtusa. Petala lanceolata multo angustiora; labellum æquilongum, integrum elongato-triangulare, basi lato. Columna stelidiis brevibus instructa, anthera ovata alba.

Gunong Tahan, 5000–6000 ft.; on rocks. (5487.)

A very curious little plant, remarkable for its stiff short stem, its short, erect raceme, and its quite simple lip.

PLATYCLINIS GRACILIS, *Hook. fil. Fl. Brit. Ind.* v. p. 708.

Gunong Tahan, 5000–6000 ft. Flowers pale greenish, with two broad stripes on the lip not reaching to the tip. (5498.) A form with a very long rhizome and stout distant bulbs.

Distrib. Perak.

P. KINGII, *Hook. fil. l. c.*

Gunong Tahan; on rocks at 6000 ft. Flowers yellow. (5434.)

Distrib. Perak and Borneo.

DENDROBIUM LONGIPES, *Hook. fil. l. c.* 713.

Summit of Gunong Tahan, 7100 ft. Flowers yellow faintly lined with brown, lip and lobes mottled with crimson. (5529.)

Distrib. Hill-ranges of the centre of the Peninsula.

D. KELSALLI, *Ridl. in Journ. Linn. Soc., Bot.* xxxii. (1896) 237.

Gunong Tahan, 3000–6000 ft.; on trees. (5496.)

Distrib. All the hills of the central range.

D. sp., with rather long bulbs, slender stems and terete acuminate leaves. "Flower pale yellow, lip spotted and veined with reddish-brown and with reddish hairs."

Gunong Tahan, 5000–6000 ft. (5481.)

This appears to be allied to *D. gracile*, Lindl., but there are no flowers on the specimens.

D. UNIFLORUM, *Griff. Notulæ*, iii. 305.

Gunong Tahan, 5000–6000 ft. (5497.) At 3300 ft. (5342, 5306.) On trees; creamy white, lip tinted with green and three brown lines down the centre.

In no. 5306 the leaves are over 2 inches long and half an inch wide, of thinner texture than those of the other two specimens. The leaves of no. 5497 are those of the Mount Ophir form, short, thick and oblong.

The Dendrobiums of the section *Distichophyllæ*, of the *D. uniflorum* and *D. revolutum* series, require critical study both in the Malay Peninsula and in Borneo, where they are also abundant on the upper parts of

the hill-ranges. There is considerable variation in the form and texture of the leaf and also in the height and habit of the plant, though the flowers seem to be much less variable.

DENDROBIUM BIFARIUM, *Lindl. Gen. & Sp. Orch.* 81.

Gunong Tahan, 5000–5500 ft. Lip creamy white with orange blotches; petals and sepals pale coffee-brown, much darker at the base. (5505.)

I cannot distinguish this from the well-known lowland plant, on which Lindley based his species, though Mr. Robinson's note as to the colour of the flower (which is usually creamy with a green lip) shows some variation from the normal. The species occurs both in the lowlands and the hill-region of the Malay Peninsula and Borneo.

D. (§ Pedilonum) CORNUTUM, *Hook. fil. Fl. Brit. Ind.* v. 730.

Gunong Tahan, 5000 ft.; on trees. Flowers bright magenta, stalks and bracts the same colour; a yellow spot on the lip. (5431.)

Distrib. Perak.

This species is closely allied both to *D. Kuhlii*, Lindl., and *D. Hasseltii*, Lindl., of Java and Sumatra. It differs but little from the latter, chiefly in the narrower acute sepals.

D. (§ Pedilonum) SUBFLAVIDUM, n. sp.

Caules plures graciles teretes, 18 poll. longi, $\frac{1}{8}$ poll. crassi, internodiis bipollicaribus. Folia anguste lanceolata acuminata acuta, 3 poll. longa $\frac{1}{2}$ poll. lata, conspicue 5-nervia, apicibus inæqualibus. Pedunculi e caulibus defoliatis $\frac{3}{4}$ poll. longi biflori. Bracteæ ovatæ. Pedicelli cum ovariis gracilibus $\frac{3}{4}$ poll. longi. Flos $1\frac{1}{2}$ poll. longus ab apice sepali usque ad apicem menti. Sepalum posticum lanceolatum $\frac{1}{4}$ poll. longum; sepala lateralia subtriangularia multo latiora, mentum cornutum 1 poll. longum, apice curvo. Labellum lanceolatum, ungue longo et anguste, limbo integro obtuso, 1 poll. longum $\frac{1}{3}$ poll. latum. Columnæ parte libera brevi lata, alis alte elevatis.

Gunong Tahan, 3300 ft. Flowers yellow. (5317.) At roots of trees; flowers pale greenish-yellow, lip yellow, spotted with crimson near the base on either side; leaves tinged with dull crimson on the under face. (5300.)

Evidently allied to *D. megaceras*, Hook. fil., a little known plant collected by Maingay in Malacca and not since found. It differs chiefly in the lip being quite entire and the limb lanceolate. *D. Anthrene*, Ridl., of Borneo is also allied.

BULBOPHYLLUM GALBINUM, *Ridl. in Journ. Linn. Soc., Bot.* xxxii. (1896) 267.

Gunong Tahan, 3300 ft.; on trees. (5305.)

Distrib. Perak.

BULBOPHYLLUM (§ Sestochilus) MICROGLOSSUM, n. sp.

Caulis longe repens $\frac{1}{12}$ poll. crassus, internodiis $\frac{1}{4}$ poll. longis ; pseudobulbis conicis ascendentibus $\frac{1}{2}$ poll. longis $\frac{1}{4}$ poll. latis ad bases. Folia elliptica obtusa, breviter petiolata coriacea $1\frac{3}{4}$ poll. longa $\frac{1}{2}$ poll. lata. Pedunculus gracilis $1\frac{3}{4}$ poll. longus. Sepalum posticum ellipticum cucullatum, sep. lateralia ovata-lanceolata falcata obtusa $\frac{1}{2}$ poll. longa. Petala lata oblongo-lanceolata obtusa fere subæqualia. Labellum minimum, basi late emarginato, apice decurvo, carnosum lateraliter compressum vix $\frac{1}{4}$ poll. longum. Columna cum pede longo sursum curvo libero, alis in margine pedis elongatis, stelidia obscura.

Gunong Tahan, 4000–5000 ft. ; on trees. Flowers dull yellow, lined and spotted with red, movable lip pink. (5327.)

Rather small-flowered for the section and with a very small lip which is flattened sideways and narrow, the base dilated and deeply emarginate. In the column, the side wings are well developed along the edge of the foot, forming rather large flanges running from the top of the column nearly to the point at which the foot becomes free from the sepals.

B. (§ Monanthaparva) TITANIA, n. sp.

Rhizoma longe repens, pseudobulbis arcte appressis tectum. Pseudobulbi oblongi apicibus ascendentibus ut in *B. catenario*, ferme $\frac{1}{2}$ poll. longis. Folia lanceolata $\frac{1}{2}$ poll. longa $\frac{1}{8}$ poll. lata, basi angustato. Pedunculus gracilis capillaris $1\frac{1}{2}$ poll. longus. Bracteæ infundibuliformes, $\frac{1}{8}$ poll. longæ. Sepala lanceolata $\frac{3}{16}$ poll. longa, 6-nervia, lateralia latiora. Petala minuta $\frac{1}{4}$ longitudinis sepali æquantia, lanceolata uninervia. Labellum linguiforme, in medio flexum $\frac{3}{4}$ longitudinis sepali æquans, carnosum flavum. Columna validula, stelidiis setiformibus longis.

Gunong Tahan, 5000–6000 ft. ; growing among moss in gullies. Flowers and stalks orange, deeper on lip and column. (5471.)

Very near *B. catenarium*, but with larger flowers and pseudobulbs. The lip is yellow and not purple, and the stelidia are as long as the body of the column.

B. (§ Racemosæ) VIRIDESCENS, n. sp.

Rhizoma longum tenue, pseudobulbis nullis. Folia breviter petiolata, petiolo crasso, lamina elliptica 1 poll. longa $\frac{3}{8}$ poll. lata crassa carnosa obtusa. Scapi filiformes 2 poll. longi, floribus paucis remotis. Bracteæ lanceolatæ acuminatæ ovaria æquantes $\frac{1}{6}$ poll. longæ. Flores pallide virides, $\frac{1}{6}$ poll. longi, carnosi. Sepalum posticum lanceolatum obtusum, sep. lateralia ad bases gibbosa sublanceolata subobtusa. Petala linearia falcata obtusa. Labellum sepalo æquale carnosum crassum linguiforme obtusum profunde canaliculatum brunneum papillosum. Columna minima, stelidiis obscuris.

Gunong Tahan, 3300 ft.; on trees. Flowers pale green, lip brown. (5313.)

Remarkable for the absence of pseudobulbs and the thick fleshy leaves, unusual in this section.

ERIA NUTANS, *Lindl. Bot. Reg.* (1840) *Misc.* 83.

Gunong Tahan, 6000 ft. Flowers white, lip and two inner petals tipped with yellow; sepals tinged with pink; bracts pale dull red. (5439.)

Distrib. A common plant all over the Peninsula.

E. (§ Hymeneria) CARUNCULATA, n. sp.

Pseudobulbi carnosi crassi subteretes, 2 poll. longi. Folia coriacea lanceolata ad basin angustata, apicibus acutis, 5 poll. longa, 1 poll. lata. Racemus ad basin florifer 5 poll. longus. Flores copiosi parvi congesti, $\frac{1}{8}$ poll. longi. Bracteæ ovatæ reflexæ, $\frac{1}{12}$ poll. longæ. Rhachis cum pedicellis rufo-tomentosa. Sepalum posticum ovatum, sep. lateralia triangularia ovata obtusa, omnia pubescentia, mentum breve rotundatum sepali limbo æquale. Petala ovata, apicibus rotundatis. Labellum sepalis longius trilobum, lobis lateralibus ovato-lanceolatis, marginibus appressis carnosis quasi callos formantibus, lobo medio cum ungue angusto et limbo trilobo obovato, lobulis rotundatis vix distinctis. Columna brevis lata subquadrata.

Gunong Tahan, 5000–6000 ft.; on rocks. Flower pallid brownish-white, lip edged with flesh-colour. (5445.)

Allied to *E. Maingayi*, Hook. fil. The lip is rather curious in form, the side-lobes meet by their inner faces over the claw of the mid-lobe, and being very fleshy almost form a callus-like mass.

E. LONGIFOLIA, *Hook. fil. Fl. Brit. Ind.* v. 790.

Gunong Tahan, 5000–5500 ft.; on trees. Flowers white, lip purple, edge of petals spotted with purple. (5515.)

Distrib. Not rare on the central hill-ranges.

E. TERETIFOLIA, *Griff. Notulæ*, iii. 298.

Gunong Tahan, 5000–5500 ft.; on trees. Flowers creamy white, base of lip pink; sweet-scented. (5527.)

Distrib. Common on trees at from 2000 feet upwards in the Peninsula and Borneo.

E. FEROX, *Bl. Mus. Bot. Lugd.-Bat.* i. 184.

Gunong Tahan, 5000–5500 ft.; on the ground. Flowers creamy white, lip mottled with purple. (5516.)

Distrib. Malay Peninsula, Java, Borneo.

ERIA (§ Dilochiopsis) SCORTECHINII, *Hook. fil. Fl. Brit. Ind.* v. 809.

Gunong Tahan, 5000 ft. Stalks up to 8 feet high; bracts white, flowers white, tinted with pink. (5433.)

Distrib. Hill-ranges of the Peninsula.

E. (§ Acridostachya) REPTANS, n. sp.

Rhizoma longe repens validum lignum, radicibus tenuibus. Pseudobulbi ascendentes, pollicem distantes, cylindrici pollicares, cum vaginis argenteis involutis. Folium in quoque pseudobulbo singulum anguste lanceolato-lineare subacutum valde coriaceum 6 pollices longum $\frac{1}{2}$ pollices latum. Scapus 12-pollicaris, basi (7 poll.) nudo rufo-tomentoso cum bracteis paucis ovatis dissitis vix $\frac{1}{12}$ poll. longis. Racemus densus 4 poll. longus, omnino rufo-tomentosus. Bracteæ minimæ ovatæ. Ovarium cum pedicello $\frac{1}{4}$ poll. longum. Sepalum posticum oblongum cucullatum, sep. lateralia ovata falcata triangularia subacuta tomentosa. Mentum $\frac{1}{6}$ poll. longum rectum cylindricum subclavatum. Petala lata ovata lanceolata glabra. Labellum oblongum rotundatum integrum, marginibus undulatis vix ad basin angustatum, fascia media incrassata minute papillosa. Columna parte libera brevi; rostellum rotundatum subemarginatum.

Gunong Tahan, 5000–6000 ft.; on rocks. Flowers pale yellow. (5446.)

Rather a striking plant for its section with its long creeping rhizomes, distant bulbs, and long wiry roots.

E. (§ Acridostachya) CRASSIPES, n. sp.

Pseudobulbi in rhizomate crasso ligneo congesti conici rugosi vaginis atrobrunneis coriaceis pollicaribus tecti. Folia bina coriacea lineari-lanceolata acuta, 5 poll. longa, $\frac{1}{2}$ poll. lata. Scapus 12 poll., dimidio inferiore nudo, argenteo-tomentosus. Racemus densus rufo-argenteo-tomentosus. Bracteæ sparsæ minimæ lanceolatæ acutæ. Sepala ovata obtusa pubescentia, lateralia semi-orbicularia. Mentum breve rectum clavatum. Petala parva angusta lanceolata curva. Labellum brevius tenue integrum oblongum flabellulatum, apice rotundato undulato. Capsula oblanceolata in uno latere fissa.

Gunong Tahan, 5000 ft. (5336.) Allied to *E. brunnea*, Ridl., but with a different lip. The specimens are nearly out of flower.

CERATOSTYLIS GRACILIS, *Blume, Bijdr.* 306.

Gunong Tahan, 5000–5500 ft. (5528.)

Distrib. Common all over the Peninsula and Java.

PHREATIA LISTROPHORA, *Ridl. in Journ. Linn. Soc., Bot.* xxxii. (1896) 307.

Gunong Tahan, 5000–6000 ft. Flowers white, strongly scented. (5469.)

Distrib. Malay Peninsula.

NEPHELAPHYLLUM PULCHRUM, *Blume, Bijdr.* 373.

Gunong Tahan, 3300 ft.; on ground among dead leaves. Lip white, lined in the centre with green and outside with dull crimson; petals dull crimson-red; leaves resembling a dead leaf. (5302.)

Distrib. Java.

TAINIA SPECIOSA, *Blume, Bijdr.* 354.

Gunong Tahan, 3300 ft.; on the ground. Flowers dull pale green lined with crimson, point of lip yellow; stalks and pseudobulbs dull purple. (5308.)

Distrib. Not rare at high elevations all over the Peninsula, also Java.

T. VEGETISSIMA, n. sp.

Rhizoma breviter repens, pseudobulbis approximatis $\frac{1}{2}$–$\frac{1}{3}$ poll. longis, vaginis papyraceis reticulatis tectis. Folium ovatum acutum margine incrassato, breviter petiolatum, $1\frac{1}{2}$–$1\frac{1}{4}$ poll. longum pollicem latum, lucidum purpurascens, nervis parallelis 6, petiolo kermesino. Scapus lateralis pseudobulbo approximatus gracilis 9 poll. longus, bracteis vaginantibus reticulatis 2 ad basin proximis, superne uno lineari circa $\frac{1}{3}$ poll. longo. Racemus laxus triflorus; bracteæ floriferæ lanceolatæ acutæ $\frac{1}{4}$ poll. longæ. Pedicellus gracilis cum ovario $\frac{1}{4}$–$\frac{2}{3}$ poll. longus. Sepala anguste lanceolata acuminata $\frac{1}{2}$ poll. longa $\frac{1}{16}$ poll. lata, inferiora basi gibba. Petala quam sepala latiora et breviora trinervia. Labellum obovato-orbiculare $\frac{1}{2}$ poll. longum, $\frac{1}{4}$ poll. latum integrum, disco kermesino margine flavo, callis semi-orbicularibus duobus ad basin instructo. Columna elongata curva gracilis, rostello rotundato integro, alis distinctis rotundatis.

Gunong Tahan, 3300 ft.; on the ground. Flowers pale yellow closely lined with crimson, lip edged with yellow, centre crimson; leaves shining purplish-brown, stalks crimson. (5314.)

A very distinct and pretty plant allied to no species very distinctly, but in some points approaching *T. grandiflora*, Ridl. Like that plant its stem and leaves suggest an affinity with *Nephelaphyllum* and there is also some similarity in the column, but the absence of the spur prevents its being referred to that genus.

SPATHOGLOTTIS AUREA, *Lindl. Paxt. Fl. Gard.* i. (1850) 16.

Gunong Tahan, 5000 ft. (5441.)

The usual big form described as *S. Wrayi*, Hook. fil. Fl. Brit. Ind. v. 813.

Distrib. Malay Peninsula, Borneo.

ARUNDINA SPECIOSA, *Blume, Bijdr.* 401.

Gunong Tahan, 5000–6000 ft.; among brushwood in ravines. Petals pale pink, lip magenta ribbed with yellow. (5448.) Common in all our hill-ranges.

Distrib. From India to Java.

CALANTHE CECILIÆ, *Reichenb. f. in Gard. Chron.* ser. II. xix. (1883) 432.

Kwala Jelai, 500–1000 ft. Flowers pure white; bracts pale green; column and lip tinged with sulphur-yellow. (5542.)

Distrib. Common in the Peninsula in some localities.

CŒLOGYNE CARNEA, *Hook. fil. Brit. Ind.* v. 838.

Gunong Tahan, 5000–6000 ft.; on low stems in shady thickets. Flowers white, lip and column streaked with yellow. (5451.)

Distrib. Perak.

C. STENOCHILA, *Hook. fil. l. c.* 837.

Gunong Tahan, 5000 ft.; on trees. Flowers pale red-brown veined with brown on the sides of the lip. (5432.)

Distrib. Perak.

C. CYMBIDIOIDES, n. sp.

Rhizoma crassum ligneum, pseudobulbis cylindricis 3-pollicaribus. Folia lanceolata acuminata longe petiolata basi cuneata, 14 poll. longa $2\frac{1}{2}$ poll. lata; nervis conspicuis elevatis 3, cum 2 minus elevatis, petiolo 3 poll. longo. Racemus longus pendulus. Flores remoti magni. Bracteæ oblongæ truncatæ papyraceæ pallide brunneæ, 1 poll. longæ, persistentes. Pedicelli $\frac{3}{4}$ poll. longi. Sepala anguste lanceolata acuta, $1\frac{1}{4}$ poll. longa, $\frac{1}{4}$ poll. lata. Petala quam sepala paullo breviora. Labellum late obovatum trilobum, lobis lateralibus magnis rotundatis, lobo medio parvo rotundato, nervis tres medianis alte cristatis præsertim ad basin, undulato-cristatis in disco et cristato-carnosis in lobo medio. Columna longa curvula, marginibus clinandrii ovatis lobatis, lobulis obtusis inæqualibus. Anthera galeata elongata cum lateribus excisis, quam clinandrium brevior, apice lato obtuso. Rostellum crassum rotundatum emarginatum.

Gunong Tahan, 5000–6000 ft. Flowers whitish, stalks pale brown, lip striped with brown, white, and yellow. (5465.)

A handsome species, allied to *C. Dayana*, Reichenb. f., but differing in the narrower pseudobulb, laxer spike, and long narrow petals and sepals.

PHOLIDOTA PARVIFLORA, *Hook. fil. Ic. Pl.* 1891.

Summit of Gunong Tahan, 7100 ft. Leaves glaucous green; flower-stalks greenish, flowers white. (5531.)

Var. PUMILA, n. var. Pseudobulbi congesti conico-oblongi, $\frac{1}{2}$ poll. longi. Folium ovatum, $\frac{3}{4}$ poll. longum, $\frac{5}{12}$ poll. latum. Racemus 2 poll. longus. Flores ferme $\frac{1}{4}$ poll. longi.

Gunong Tahan, 7100 ft. (5530.)

So different in habit from the typical form as to appear at first sight a very distinct species. As, however, the flowers are similar, I conclude that it is merely a condensed form due to its habitat.

BROMHEADIA ALTICOLA, *Ridl. in Journ. Linn. Soc., Bot.* xxviii. (1891) 338.
Gunong Tahan, 3300 ft. Flowers creamy white. (5428.) Common at high and low altitudes on trees.
Distrib. Selangor, Singapore.

THRIXSPERMUM SCORTECHINII, *Ridl. Fl. Mal. Pen., Monocot.* i. 183.
Gunong Tahan, 5000–5500 ft.; on trees. (5512.)
Distrib. Malay Peninsula.

APPENDICULA RUPESTRIS, *Ridl. in Journ. Linn. Soc., Bot.* xxxii. (1896) 391.
Kwala Tahan, 500–1000 ft. Flowers yellowish-white; top of column pink. (5537.) From the type-locality.

ACRIOPSIS JAVANICA, *Blume, Bijdr.* 337.
Gunong Tahan, 4000–5000 ft. (5412.) Fruiting specimen only.
Distrib. Malay Peninsula, Tenasserim, Sumatra, Java.

HETÆRIA ELEGANS, n. sp.
Caulis 3 poll. longus. Folia ovata acuminata acuta trinervia, 3 poll. longa 1 poll. lata, glabra, petiolo vaginante $1\frac{1}{2}$ poll. longo. Pedunculus cum racemo 18-pollicari, basi (12 poll.) nudo. Racemus multiflorus, laxiusculus; rachis albopubescens. Flores vix plus quam $\frac{1}{12}$ poll. longi, pedicello cum ovario $\frac{1}{4}$ poll. longo. Bracteæ lanceolatæ acuminatæ. Sepala ovata obtusa glabra. Petala anguste linearia apicibus dilatatis. Labellum quam sepala brevius oblongum ovatum saccatum, cum processibus carnosis clavatis pluribus in sacco; caruncula carnoso in apice labelli. Columna basi angusta, superne dilatata. Rostellum late excisum, lobis latis obtusis.
Gunong Tahan, 5000–6000 ft. Flowers greenish. (5466.)
Near *H. elata*, Hook. fil., of Batang Padang, but differs in having a laxer spike, narrower petals, and a different lip.

HABENARIA ZOSTEROSTYLOIDES, *Hook. fil. Fl. Brit. Ind.* vi. 155.
Gunong Tahan, 5000–6000 ft. Flowers greenish. (5480.)
Distrib. Also occurs on Mt. Ophir and other hills in the Peninsula.

CYPRIPEDIUM BARBATUM, *Lindl. Bot. Reg.* (1841) *Misc.* 53.
Gunong Tahan, 5000–6000 ft. Leaves chequered pale green and white; lateral petals spotted with black-purple terminally. (5442.) Specimen in fruit only; determination doubtful.
Distrib. Malay Peninsula, Siam.

APOSTASIACEÆ.

APOSTASIA NUDA, *R. Br. in Wall. Pl. As. Rar.* i. 76.
Gunong Tahan, 3300 ft. Flowers white. (5318.)
Distrib. Common in the Peninsula; also North-East India; Sumatra, Java.

ZINGIBERACEÆ.

HEDYCHIUM COLLINUM, *Ridl. in Journ. Roy. As. Soc. Straits Br.* xxxii. (1899) 103.

Gunong Tahan, 5000–5600 ft. Flowers white, stamens brownish; strongly scented. (5513.) Apparently the same species as I obtained on Kedah Peak, but a bigger and taller plant about 5 feet high. I had only one rather stunted plant from a somewhat exposed precipice. The calyx and corolla-tube are pubescent in this plant.

ZINGIBER GRACILE, *Jack, in Mal. Misc.* i. (1820) no. I. 1.

Gunong Tahan, 3300 ft. (5365.) Exactly the ordinary form as far as the specimen goes, but the field-note says: "Flowers pale yellow, bracts yellow, lower ones streaked with green; flower-stalk dull red." The bracts of this species are normally dull red.

CAMPTANDRA PARVULA, *Ridl. l. c.* 104.

Kwala Teku, 500–1000 ft. Flowers white, throat yellow. (5532.)

Distrib. Malay Peninsula.

CONAMOMUM UTRICULOSUM, *Ridl. l. c.* 122.

Gunong Tahan, 3300 ft. Flowers yellow. (5424.)

Distrib. Perak Hills.

GEOSTACHYS ELEGANS, *Ridl. l. c.* 160.

Gunong Tahan, 5000–5500 ft. Flowers yellow, the sides of the lip mottled with red, the lower surface of the leaves purple. (5511.)

Distrib. Mount Ophir.

This is quite like the Mount Ophir plant, but the stamen in the one perfect flower I was able to examine has a distinct little lacerate crest.

LILIACEÆ.

DRACÆNA PORTERI, *Baker, in Journ. Bot.* xi. (1873) 262.

Gunong Tahan, 3300 ft. Flowers white, leaves green; about 3 feet high (5371.)

Distrib. Common all over the Peninsula; Singapore, Siam.

BURMANNIACEÆ.

BURMANNIA DISTICHA, *Linn. Sp. Pl.* 287.

Gunong Tahan, 4000–5000 ft. Flowers light green; bracts pale violet. Growing among low scrub, on ridges (5383). On damp places in open (5449). Common at high elevations.

Distrib. India, Sumatra, China, Australia.

B. LONGIFOLIA, *Becc. Malesia*, i. 244.

Gunong Tahan, 3300 ft. Flowers and bracts white, petals tinted on edges pale blue. (5230.) Usually with the last.

Distrib. Malay Peninsula, Borneo.

XYRIDACEÆ.

XYRIS GRANDIS, n. sp.

Herba valida; foliis magnis late ensiformibus acuminatis equitantibus subcoriaceis, 24 poll. longis, $\frac{3}{4}$ poll. latis. Scapus brevior, 19 poll. longus, teres. Capitulum obovatum magnum $\frac{1}{2}$ poll. in diametro. Bracteæ exteriores lanceolatæ acutæ $\frac{1}{2}$ poll. longæ, atrobrunneæ lucidæ. Sepala 3 inæqualia, lanceolata acuta cartilaginea atrobrunnea. Petala 3 cuneato-oblonga, marginibus laceratis, flava. Stamina oblonga glabra. Stylus cum brachiis 3 elongatis extrusis.

Gunong Tahan, 3300 ft. Flowers yellow, leaves green tinted with red, brown at the base. (5341.)

This is the finest *Xyris* I know; the great sword-like leaves recall those of *Cladium Maingayi*, C. B. Clarke, of Mt. Ophir, and are quite unlike those of any other species.

X. RIDLEYI, *Rendle, in Journ. Bot.* xxxvii. (1899) 505.

Gunong Tahan, 5000–6000 ft., in damp places on rocks. Flowers bright cadmium-yellow, turning white. (5450.)

Distrib. Kedah Peak.

The original specimen from Kedah Peak is somewhat taller with slightly larger heads, but the plants from the two localities are evidently conspecific (A. B. R.).

ARACEÆ.

SCINDAPSUS SCORTECHINII, *Hook. fil. Fl. Brit. Ind.* vi. 541.

Gunong Tahan, 3300 ft., climbing on trees. Whole flower pale yellow. (5307.)

Distrib. Common in all the hill districts in the Peninsula.

ERIOCAULONACEÆ.

ERIOCAULON MACROPHYLLUM, *Ruhl., in Engl. Pflanzenr., Erioc.* 77.

Gunong Tahan, 5000–5000 ft. Flower-heads greyish-white. (5510.)

I take this to be a form of the Javan plant described by Ruhland, but have seen no type. Plants collected by Horsfield at Rawa Diyang seem to be the same thing.

GYMNOSPERMÆ.

CONIFERÆ.

AGATHIS LORANTHIFOLIA, *Salisb. in Trans. Linn. Soc.* viii. (1807) 312.

Gunong Tahan, 5000–6000 ft. Tree from 35–40 feet high, in sheltered gullies. (5488.)

Distrib. Malay Peninsula and Archipelago.

DACRYDIUM ELATUM, *Wall. ex Hook. Lond. Journ. Bot.* ii. (1843) 144.
Gunong Tahan, 3300 ft. Tree 60–80 feet tall. (5380.)
Distrib. Common at high altitudes in the Peninsula and Archipelago.

PODOCARPUS CUPRESSINA, *R. Br. ex Mirb. in Mém. Mus. Par.* xiii. (1825) 75.
Gunong Tahan, 3300 ft. Tree 50–60 feet high. (5354.)
Distrib. Common at such altitudes in the Peninsula and Islands.

P. BRACTEATA, *Blume, Enum.* i. 88.
Gunong Tahan, 5000–6000 ft. Tree 20 feet high, branches at right angles to the stem. (5452.)
Distrib. Not previously recorded from the Malay Peninsula; Java.

PTERIDOPHYTA.

(With A. GEPP, M.A., F.L.S.)

GLEICHENIA DICARPA, *R. Br. Prodr.* 161.
Gunong Tahan, 4000–5000 ft. (5407.)

G. NORRISII, *Mett. ex Kuhn, in Linnæa,* xxxvi. (1869–70) 165.
Gunong Tahan, 3300 ft.; climbing fern. Leaves bluish-white beneath. (5358.)

CYATHEA BRUNONIS, *Wall. ex Hook. Sp. Fil.* i. 15.
Gunong Tahan. (5379.)

ALSOPHILA KINGI, *C. B. Clarke, ex Bedd. Handb. Ferns Brit. Ind.* 475.
Gunong Tahan, 3300 ft. Tree-fern, stem about 4 feet high. (5425.)

MATONIA PECTINATA, *R. Br. in Wall. Pl. Asiat. Rar.* i. t. 16.
Gunong Tahan, 3300 ft. (5351.)

LECANOPTERIS CARNOSA, *Blume, Enum. Pl. Jav.* 120.
Gunong Tahan, 4000–5000 ft.; growing on trees on ridges. (5389.)

HYMENOPHYLLUM POLYANTHOS, *Sw. in Schrad. Journ.* 1800, 102.
Gunong Tahan, 3300 ft.; growing in damp places on trees. (5422.)

TRICHOMANES PALLIDUM, *Blume, Enum. Pl. Jav.* 225.
Gunong Tahan, 5000–6000 ft.; on damp shady rocks. (5474.)

T. DIGITATUM, *Sw. Syn. Fil.* 370, 422.
Gunong Tahan, 4000–5000 ft.; growing on rocks. Pale olive-green. (5401.)

T. PLUMA, *Hook. Ic. Pl.* t. 997.
Gunong Tahan, 3300–5000 ft. (5359, 5385.)

TRICHOMANES APIIFOLIUM, *Presl, Hymenoph.* 16, 44.
Gunong Tahan, 3300 ft.; growing in damp places. (5421.)

T. RADICANS, *Sw. in Schrad. Journ.* 1800, 97.
Gunong Tahan, 3300 ft.; growing in damp places. (5419.) Specimen in very shrivelled condition, but apparently this species.

HUMATA PEDATA, *J. Smith, in Hook. Journ. Bot.* iii. (1841) 416.
Gunong Tahan, 5000–6000 ft.; growing on trees. (5437, 5472.)

DAVALLIA PINNATA var. GRACILIS, *Hook. & Bak. Syn. Fil.* 98.
Gunong Tahan, 3300 ft. (5377.)

LINDSAYA RIGIDA, *J. Smith, l. c.* 415.
Gunong Tahan, 5000 ft. (5547.)

L. CULTRATA, *Sw. Syn. Fil.* 119.
Gunong Tahan, 5000–5500 ft.; on rocks. (5521.)

L. SCANDENS, *Hook. Spec. Fil.* i. 205.
Gunong Tahan, 3300 ft.; climbing fern on trees. (5368, 5418.)

L. FLABELLULATA, *Dryand. in Trans. Linn. Soc.* iii. (1797) 41.
Gunong Tahan, 3300 ft. (5372.)

L. DIVERGENS, *Wall. ex Hook. & Grev. Ic. Fil.* t. 226.
Gunong Tahan, 3300 ft. (5373.)

OLEANDRA NERIIFORMIS, *Cav. in Anal. Hist. Nat.* i. (1799) 115.
Gunong Tahan, 3300 ft.; climbing fern. (5357.)

DIPTERIS HORSFIELDII, *Bedd. Ferns Brit. Ind.* t. 321.
Gunong Tahan, 3300 ft. (5350.)

POLYPODIUM HIRTUM, *Hook. Spec. Fil.* iv. 170.
Gunong Tahan, 5000–6000 ft.; growing on trees. (5478.)

P. STREPTOPHYLLUM, *Baker, in Journ. Bot.* xvii. (1879) 42.
Gunong Tahan, 4000–5000 ft.; growing on rocks. (5394.)

P. CUCULLATUM, *Nees & Blume, in Nova Acta,* xi. (1823) 121.
Gunong Tahan, 5000–5500 ft.; on rocks. (5522.)

P. VENULOSUM, *Blume, Enum. Pl. Jav.* 128.
Gunong Tahan, 5000–6000 ft.; growing on trees. (5463.)

P. (Phymatodes) STENOPHYLLUM, *Blume, Enum. Pl. Jav.* 124.
Gunong Tahan, 4000–5000 ft.; growing on trees. (5386.)

Polypodium Wrayi, *Baker, in Journ. Bot.* xxv. (1887) 206.
Gunong Tahan; growing on rocks at 5000–6000 ft. (5494.)

P. laciniatum, *Blume, Enum. Pl. Jav.* 131.
Gunong Tahan, 5000–6000 ft.; growing on damp rocks. (5459.)

Vittaria falcata, *Kunze, in Bot. Zeit.* vi. (1848) 198.
Gunong Tahan, 3300 ft.; growing on trees. (5301.)

Tænitis blechnoides, *Sw. Syn. Fil.* pp. 24, 220.
Gunong Tahan, 3300 ft.; growing on the ground. (5345.)

Elaphoglossum latifolium, *J. Smith, in Hook. Lond. Journ. Bot.* i. (1842) 197.
Gunong Tahan, 5000–6000 ft.; growing on trees. (5464.)

Schizæa malaccana, *Baker, Syn. Fil.* 428.
Gunong Tahan, 4000–5000 ft.; growing on the ground and on trees. (5403.)

Lycopodium casuarinoides, *Spring, Monogr. Lycop.* i. 94.
Gunong Tahan, 4000–5000 ft.; climbing among high bushes, &c. (5398.)

L. nummularifolium, *Blume, Enum. Pl. Jav.* ii. 263.
Kwala Teku, 500–1000 ft. (5541.)

Selaginella plumosa, *Baker, in Journ. Bot.* xxi. (1883) 144.
Gunong Tahan, 3300 ft.; growing on the earth in jungle. (5361.)

S. Wallichii, *Spring, Monogr. Lycop.* ii. 143.
Gunong Tahan, 3300 ft. Stalks dull red. (5414.)

S. atroviridis, *Spring, l. c.* 124.
Gunong Tahan, 3300 ft. Green, stalks dull red. (5366.)

BRYOPHYTA.

(By A. Gepp, M.A., F.L.S.)

Sphagnum Junghuhnianum, *Doz. & Molk. Bryol. Jav.* i. 27.
Gunong Tahan, 6000 ft. Pale green, the tops pale reddish-brown. (5435.)

Eucamptodon macrocalyx, *C. Müll. Syn. Musc.* i. 346.
Gunong Tahan, 5000–5500 ft.; growing on 5527 (*Eria teretifolia*).

Leucobryum chlorophyllosum, *C. Müll. Syn. Musc.* ii. 535.
Gunong Tahan, 3300 ft.; growing on trees. (5420.)

Trichosteleum scabrellum, *Jaeg. & Sauerb. Sp. & Gen. Musc.* ii. 484.
Gunong Tahan, 3300 ft.; growing on small tree. (5417.)

MNIODENDRON DIVARICATUM, *Lindb. in Öfv. Vet.-Akad. Förh. Stockh.* xviii. 1861 (1862) 375.
Gunong Tahan, 5000–6000 ft. Fruit yellowish. (5490.)

MASTIGOBRYUM sp.
Gunong Tahan, 3300 ft. (5374.)

LEPIDOZIA WALLICHIANA, *Gottsche, Syn. Hepat.* 204.
Gunong Tahan, 3300 ft.; on dead tree. Delicate pale green. (5360.)

LICHENES.

(By Miss A. LORRAIN SMITH, F.L.S.)

STEREOCAULON CORALLOIDES, *Fries, Sched. Crit.* iv. 24, var.
Gunong Tahan, 3300 ft.; growing amongst moss. Colour very pale sea-green. (5348.)

USNEA DASYPOGA, *Nyl. ex Stiz. in St. Gall. Nat. Ges.* (1876) 202.
Gunong Tahan, 3300 ft.; growing on branches of trees. Dull; very pale green. (5353.)

CLADONIA MACILENTA, *Hoffm. Deutschl. Fl.* 126.
Gunong Tahan, 4000–5000 ft.; on trees. Pale dull green; fruiting tops bright red. (5402.)

C. RANGIFERINA, *Hoffm. l. c.* 114.
Gunong Tahan, 5000 ft.; growing on the ground White, slightly tinged with green. (5331.)

FUNGI.

(By Miss A. LORRAIN SMITH, F.L.S.)

HEXAGONIA TENUIS, *Fries, Epicr.* 498.
Gunong Tahan, 3300 ft.; on dead wood. Shaded with warm brown above, brown powdered with white beneath. (5423.)

LACHNOCLADIUM BRASILIENSE, *Sacc. Syll. Fung.* vi. 738.
Gunong Tahan, 3300 ft.; on dead wood. Very pale brown. (5416.)

PANUS sp.
Gunong Tahan, 3300 ft.; on dead wood. White shaded with warm brown above, pure white beneath. (5310.)

CLAVARIA FUSIFORMIS, *Sowerby, Engl. Fungi,* t. 234.
Gunong Tahan, 3300 ft.; growing among moss, &c. Whole plant ochre-yellow. (5346.)

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THE JOURNAL

OF

THE LINNEAN SOCIETY.

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Brassica Crosses. By Arthur W. Sutton, F.L.S.

(Plates **24–35**.)

[Read 16th January, 1908.]

In 1899 I was attracted to the study of crosses among species and varieties of Brassicas by a statement in one of the leading agricultural journals that certain types mentioned by the writer do not hybridize naturally, and therefore can be grown in close proximity to each other without fear of destroying the highly selected forms which the seedsman is at so much pains to keep true.

As experience gained during many years' association with practical seed-growing convinced me that the statement was incorrect, I decided to put the matter to a practical test in order to place on record the results obtained, and to show which species and varieties of *Brassica* would intercross and which would not.

In the first experiments, begun in 1900, the varieties of *Brassica oleracea*, L., shown in figs. 1 to 9 (Pl. **24**), were planted side by side so that cross-fertilization might take place wherever such was possible. (For names of these varieties see list on page 347.)

The seed saved from these plants gave rise to an extremely heterogeneous collection of nondescript forms, few or none of which were true to the female parental type. Various types, however, were noticed which there was every reason to believe would, if it were possible to perpetuate them, become valuable additions to the economic plants of the farm or garden. From these the forms represented in figs. 10, 11, 12, & 13 (Pl. **25**) have been fixed, and come fairly true from seed.

In a later season the experiment was repeated with the addition of varieties of Turnips (*Brassica Rapa*, L.), Swedes (*Brassica campestris*, L., var. *Napo-brassica,* DC.), and non-bulbing oil-yielding Rape (*Brassica campestris*, var. *oleifera*, DC.).

Instead, however, of all being planted in one large patch, they were arranged in small isolated groups of seven plants each. Two of the plants were of one variety, and round them were placed five of another kind. In this manner about twenty such double combinations were arranged and the seed saved and grown.

A large collection of mongrel plants was obtained; the results were entirely in accordance with my previous experience, and proved that while no variety derived from *Brassica oleracea* was affected by the pollen of Rape, Swede or Turnip, and *vice versa*, yet all the types of *B. oleracea* would freely intercross between themselves, and this was equally true of many varieties of Turnip, Swede, and Rape.

Hitherto I had been content to note such species of *Brassica* as would

intercross when planted in close association, but looking over the plants raised in the last experiment with Professor Percival of University College, Reading, we concluded that the experiment would be far more complete if a series of carefully controlled artificial crosses were undertaken in order to ascertain whether some of the species or varieties which had not naturally intercrossed in the previous experiment, might do so when the flowers were artificially pollinated.

The Brassicas selected for this experiment are shown on Plate **26**, and consist of :—

Fig. 16. Colza Rape (*Brassica campestris*, L., var. *oleifera*, DC.). Resembles the Swede in its glaucous leaves, which when young are hispid, but its flowers are bright canary-yellow.

,, 17. Ragged Jack Kale. A plant resembling in general character the Colza Rape and Asparagus Kale, but with laciniated leaves.
,, 18. Asparagus Kale closely allied to Colza Rape.
} Flowers bright canary-yellow.

,, 19. Kohl Rabi (*Brassica oleracea*, L., *caulo-rapa*).
,, 20. Thousand-headed Kale (*Brassica oleracea*, L. *acephala*).
,, 21. Drumhead Cabbage (*B. oleracea*, L., *capitata*).
} The flowers of these three types are almost alike and of a pale yellow colour.

Swede Turnips, viz.:—

,, 22. Purple-top Round White-fleshed (*Brassica campestris*, L., var. *Napo-brassica communis*, DC.).
Flowers bright canary-colour.

,, 23. Purple-top Round Yellow-fleshed
,, 24. ,, Tankard ,,
} *Brassica campestris*, L., var. *Napo-brassica Rutabaga*, DC.
Flowers pale buff-colour.

Turnips, viz. :—

,, 25. { Green-top Yellow-fleshed / Purple-top Yellow-fleshed } ? *Brassica Rapa*, L.
Flowers pale buff-colour.

,, 26. Purple-top White-fleshed
,, 27. Green-top White-fleshed
} *Brassica Rapa*, L.
Flowers bright canary-colour.

From this point I had the advantage of the able assistance of Professor Percival, who personally emasculated the blooms and applied the desired pollen.

The chief objects we had in view were :—

(1) To determine which varieties of *Brassica* would cross with each other, and whether the plants of the first filial generation (F 1) were fertile or sterile.

(2) To draw such conclusions as might be possible from results thus obtained concerning the origin of the principal distinct types of Swedes and Turnips, and more especially to ascertain whether the White-fleshed and Yellow-fleshed Swedes had a common origin, as also the White-fleshed and Yellow-fleshed Turnips.

(3) To ascertain whether a Yellow-fleshed Turnip similar to those termed "Hybrid Turnips" by some seedsmen and farmers could be produced by crossing the Swede (*Brassica campestris*, L., var. *Napo-brassica*, DC.) with the White-fleshed Turnip (*Brassica Rapa*, L.).

(4) Incidentally we wished to obtain light upon the relationship of the different cultivated forms of *Brassica.*

Arising out of these experiments it became evident that the results had a definite bearing on Mendelian phenomena.

The plants used for crossing were grown in the open trial grounds, but flowers selected for fertilization were very carefully emasculated before the stamens were ripe, and enclosed in small paper envelopes. The pollen was obtained only from flowers which were allowed to open inside close-fitting paper bags to prevent the possibility of stray pollen becoming mixed with that which was to be used in the experiments.

Many apparently unopened flowers were found to be useless for our purpose on account of the attack of minute larvæ of species of *Meligethes* and *Cecidomyia*, which had fed on the immature pollen in the anther lobes and scattered some of it in the inside of the flowers.

In addition to the greatest care in emasculation and in the exclusion of insects large and small, each stigma was examined with a Coddington lens to make certain of its clean state before the application of the pollen.

Over 80 distinct crosses were attempted.

Taking into consideration the results obtained from them, they may be arranged in three groups, viz. :—

Group I. Crosses from which no seed was obtained.

" II. Those plants from which seeds were produced but the plants raised from them proved self-sterile.

" III. Those plants from which seeds were obtained and the plants from which were quite fertile among themselves.

Group I.—No seed resulted from the pollination of

Cabbage Thousand-headed Kale Kohl Rabi	with	Swedes, Turnips, Colza Rape, Asparagus Kale, Ragged Jack Kale,

or the reverse pollinations.

In some instances the pollen appeared to act as a stimulus to the growth of the pericarp of the fruit, the pods growing to the normal size or even larger, but the ovules were abortive.

Group II.—To this group belongs the cross

♂ White-fleshed Turnip on ♀ Swede, and its reciprocal ♂ Swede on ♀ White-fleshed Turnip,

which proved remarkable in many ways.

When the Swede is fertilized by the Turnip, that is, when the Swede is made the seed-bearer, the seeds obtained are abundant. They are large black-coated like those of the typical Swede, and contain embryos which grow vigorously into fine healthy plants.

In the reciprocal cross, that is, where the Turnip is fertilized by Swede pollen, the Turnip being the seed-bearer, the seeds produced are rather paler in coat colour than those of the normal Turnip and always smaller and shrivelled. Moreover, it is difficult to germinate and rear seedlings from them in open ground, though there is little difficulty in doing this with the seeds of the reverse cross.

These points have been tested many times during two seasons, always with the same results.

At first the seeds of the crosses were sown in carefully prepared beds in the open ground; and from the fact that no plants were obtained from the seeds of the Swede ♂ on Turnip ♀ cross, we were inclined to conclude that the embryos in the seeds were abortive and incapable of growth.

However, in 1906 seeds, from reciprocal crossings, were again obtained, the same striking differences in size, colour, and shape as were seen in the seeds before, but instead of sowing them at once in the open ground they were germinated on blotting-paper and the seedlings planted out. Those of the Swede ♂ on Turnip ♀ were weak, but after careful management ultimately grew into plants as large as those from the Turnip ♂ on Swede ♀ cross. Moreover the characters of the full-grown plants proved to be the same whichever way the cross was made.

The general facies of the plants was intermediate between the two parents. The leaves were glaucous like Swede leaves, but more hispid and more like those of the Turnip in shape. The "bulb" resembled the Swede in form

and neck perhaps more than the Turnip, but the flesh was white like the latter. The flowers were almost as large as those of the Swede, but canary-yellow in colour like those of the White-fleshed Turnip or White-fleshed Swede. They were abundant and apparently normal, but produced no seed although many were pollinated by hand. It was discovered later that the pollen was abnormal in form and structure, many of the pollen mother-cells having undergone peculiar changes which we hope to investigate further in the coming season.

The very marked sterility and the intermediate character of the plants obtained when the Swede (*Brassica campestris*, L., var. *Napo-brassica Rutabaga*, DC.) and White-fleshed Turnip (*Brassica Rapa*, L.) are crossed, seem to point strongly to the conclusion that they are true hybrids and that the parents are specifically distinct.

Apart from the fact that the plants are sterile, they are so different in character from the so-called "hybrid" yellow-fleshed Turnip, that it does not appear likely that the latter has originated by crossing the Swede and Turnip.

In addition to the Turnip × Swede cross just described, many others were made, including the following, which should probably be placed in this group:—

Colza Rape	on	Yellow-fleshed Tankard Swede.
Colza Rape	on	White-fleshed Round Swede.
Colza Rape	on	Yellow-fleshed Turnip.
White-fleshed Turnip	on	Colza Rape.
White-fleshed Turnip	on	White-fleshed Round Swede.
White-fleshed Turnip	on	Asparagus Kale.
White-fleshed Turnip	on	White-fleshed Swede.
White-fleshed Turnip	on	Yellow-fleshed Turnip.
White-fleshed Turnip	on	Yellow-fleshed Swede.
Yellow-fleshed Turnip	on	Colza Rape.
Yellow-fleshed Turnip	on	Ragged Jack Kale.
Yellow-fleshed Turnip	on	Yellow-fleshed Swede.
Yellow-fleshed Turnip	on	Ragged Jack Kale.
Yellow-fleshed Turnip	on	White-fleshed Swede.
Yellow-fleshed Turnip	on	White-fleshed Turnip.
Asparagus Kale	on	Yellow-fleshed Tankard Swede.
Ragged Jack Kale	on	Yellow-fleshed Tankard Swede.
Yellow-fleshed Round Swede	on	Ragged Jack Kale.

From all these crosses hybrid plants were obtained, many of which proved sterile, while others unfortunately died off in the winter before the question of their fertility or sterility could be ascertained.

The most interesting of these are shown in figs. 28 to 57 (Pls. **27** to **29**).

Group III.—In this series of crosses abundant seed was produced, and plants of the F 1 and F 2 generation were easily raised.

The seeds from the F 1 generation were sown and about 200 plants from them were grown for observation. In the second filial generation (F 2) segregation occurred in all cases.

In order to obtain an impartial estimate of the numbers and characters of the plants, neither Professor Percival nor myself had anything to do with the classification of the segregated plants, this being left to the judgment of one of our assistants who had no inclination to look for Mendelian numbers. Many of the results, as will be seen below, are confirmatory of Mendel's laws. Where the figures appear to disagree with the well-known ratios among segregated plants of the F 2 generation, it is possible that the discrepancy may be due to the great difficulty in deciding into which group individual plants should be placed.

♂ Ragged Jack Kale on ♀ White Swede.

Ragged Jack Kale (Pl. 30. fig. 58) is a form of *Brassica* which in general habit and flower resembles a Colza Rape but the leaves are laciniate. The Swede used for the female parent was a white-fleshed variety with purple top (fig. 59).

The plants of F 1 had strong Swede-like leaves; they were however slightly more incised at the margins than the normal Swede parent, indicating the influence of the Ragged Jack parent. The rootstock was thick with little tendency to "bulbing" (fig. 60).

The plants of the F 2 generation, of which 198 were grown, were of several forms. There were bulbing and non-bulbing plants, some having leaves like the Swede, others the laciniate form of the Ragged Jack Kale.

The following were the classes into which the plants of this generation were divided together with numbers belonging to each class.

As regards foliage there were found—

142 with Swede foliage.
38 ,, Ragged Jack foliage.
18 ,, Intermediate foliage.

From the Mendelian ratio of 3 to 1, where Swede is dominant, we should expect from 196 plants—

147 with Swede foliage.
49 ,, Ragged Jack foliage.

As regards the bulbing character there were—

	Found (198 plants).	Expected (from 196 plants).
Bulbed	160	147
Bulbless	38	49

Probably some of the 160 plants with bulbs should have been placed in the bulbless group, since it is difficult to distinguish slight bulb from a merely thickened stem due to increased vigour.

Classifying the plants obtained into groups with two pairs of characters in each, and an intermediate group, there were—

			Found (198 plants).		Expected, according to the Mendelian ratio of 9.3×3.1, from 199 plants.
Fig. 61.	Bulbed with	Swede foliage	117		112
,, 62.	,, ,,	Ragged Jack foliage	30	43	37
,, 63.	,, ,,	Intermediate foliage	13		
,, 64.	Bulbless ,,	Swede foliage	25		37
,, 65.	,, ,,	Ragged Jack foliage	8	13	13
,, 66.	,, ,,	Intermediate foliage	5		

The intermediate plants showed evidence of Ragged Jack laciniation, and should no doubt be placed with the Ragged Jack plants as indicated.

♂ White Swede on ♀ Ragged Jack Kale.

This was the reciprocal of the preceding cross (see figs. 58 & 59).

The plants of F 1 were bulbless and very similar to those of F 1 in the previous cross, but weaker in growth and slightly divided ; the foliage was like that of the Swede with slight indication of Ragged Jack parent (see Pl. **31.** fig. 67).

The plants of F 2 are shown at figs. 68 to 73 and tabulated below.

As regards foliage there were—

Found (194 plants).		Expected, 3 : 1 (from 192 plants).
156	with Swede foliage	147
33	,, Ragged Jack foliage	49
5	,, Intermediate foliage	

As regards bulbing character there were—

	Found (194 plants).	Expected (from 192 plants).
Bulbed	136	147
Bulbless	58	49

Classifying the plants into groups with two pairs of characters associated the results came out thus :—

			Found (194 plants).		Expected, 9.3×3.1 ratio (from 192 plants).
Fig. 68.	Bulbed with	Swede foliage	109		108
,, 69.	,, ,,	Ragged Jack foliage	23	27	36
,, 70.	,, ,,	Intermediate foliage	4		
,, 71.	Bulbless ,,	Swede foliage	47		36
,, 72.	,, ,,	Ragged Jack foliage	10	11	12
,, 73.	,, ,,	Intermediate foliage	1		

♂ Kohl Rabi on ♀ Thousand-headed Kale.

There is little need to describe the parent plants minutely. The Kohl Rabi has a thickened bulbous stem with broad thinnish leaves, the Thousand-headed Kale having an elongated and very much branched stem bearing large numbers of leaves (figs. 74 & 75).

The plants of F 1 were somewhat intermediate in character between the parents (fig. 76).

Segregation took place in the F 2 generation, the results being as follows. As regards the bulbing character there were :—

	Found (207 plants).	Expected (from 208 plants).
Bulbed	154	156
Bulbless	53	52

Pl. **32.** fig. 77. 60 of the bulbed plants very closely resembled the Kohl Rabi grandparent in bulb, but had strong Thousand-headed Kale foliage.

„ 78. 94 had similar Thousand-headed Kale foliage, but the bulbing character was not so pronounced.

„ 79. 53 had elongated thickened stems shorter than the typical Thousand-headed Kale; the foliage was like that of the latter plant.

♂ Thousand-headed Kale on ♀ Kohl Rabi.

This is the reciprocal of the preceding cross (see figs. 74 & 75).

The plants of F 1 were intermediate in character between the parents as before described, having Thousand-headed Kale foliage and slight bulbing tendency (fig. 80).

In F 2 the following results were obtained (figs. 81, 82, 83, & 84) :—

As regards the bulbing character there were—

	Found (201 plants).	Expected (from 200 plants).
Bulbed	135	150
Bulbless	66	50

The bulbed plants included 44 well-developed Kohl Rabi against 60 in the reverse cross, and 66 slightly bulbed against 94 in the reverse cross. But amongst the bulbless plants none were seen resembling the Thousand-headed Kale as in the reverse cross, though there were 38 with broad leaves like a Cabbage, quite unlike either parent.

Fig. 81. 44 were almost pure Kohl Rabi with coarse foliage.

„ 82. 91 like the 94 in the reverse, *i. e.* Thousand-headed Kale foliage and slight bulb.

Grout, sc.

BRASSICA CROSSES.

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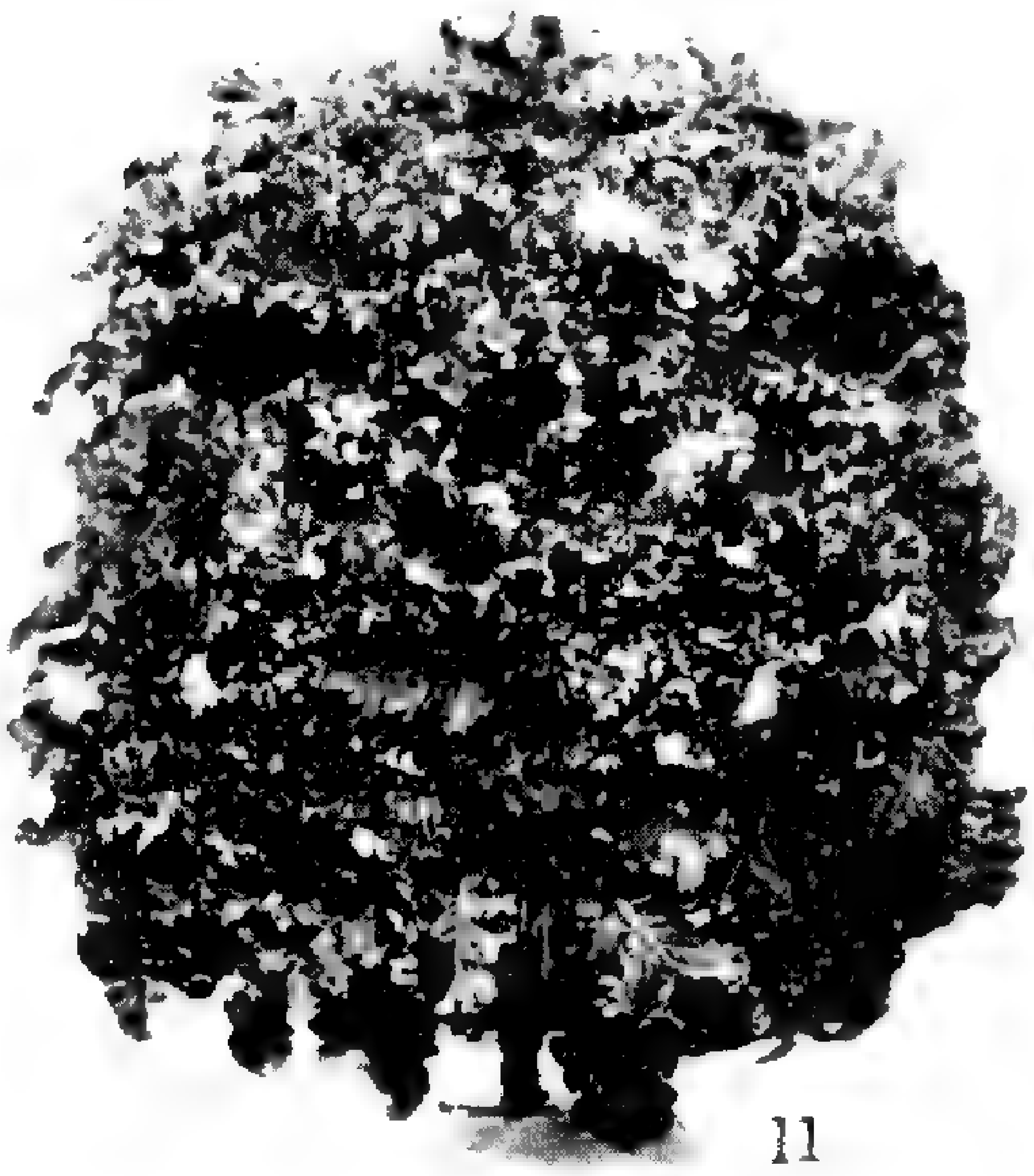

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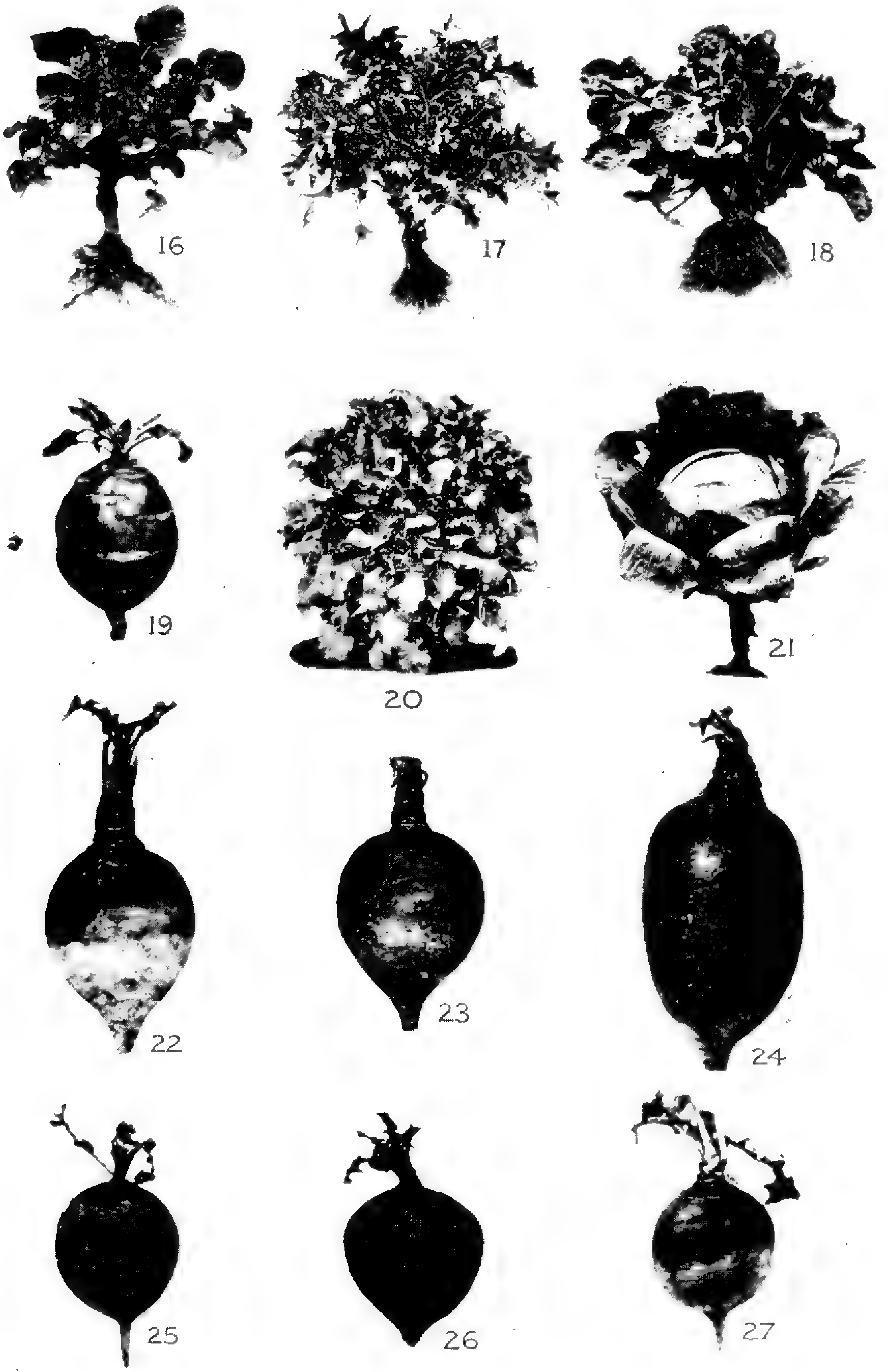
BRASSICA CROSSES.



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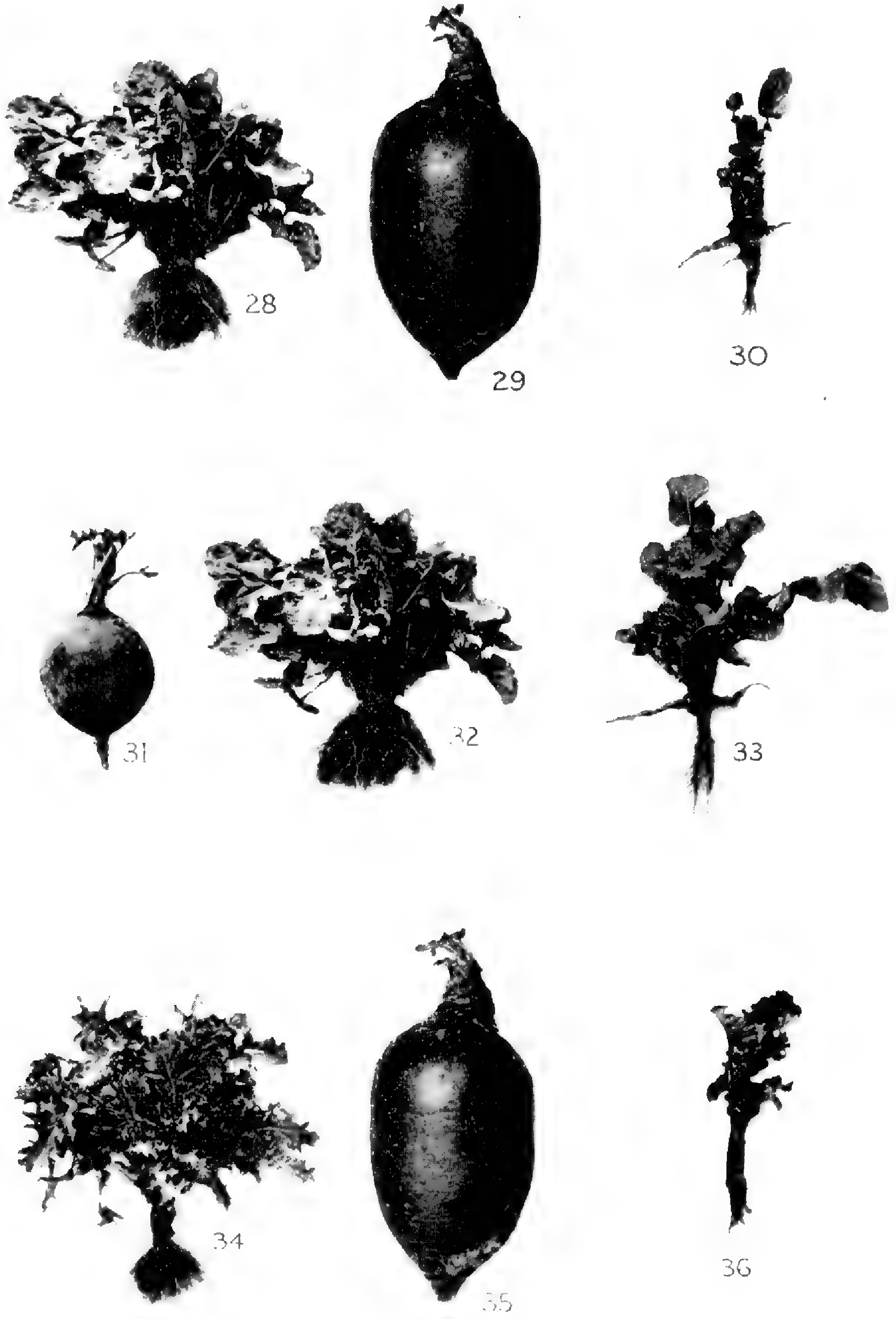

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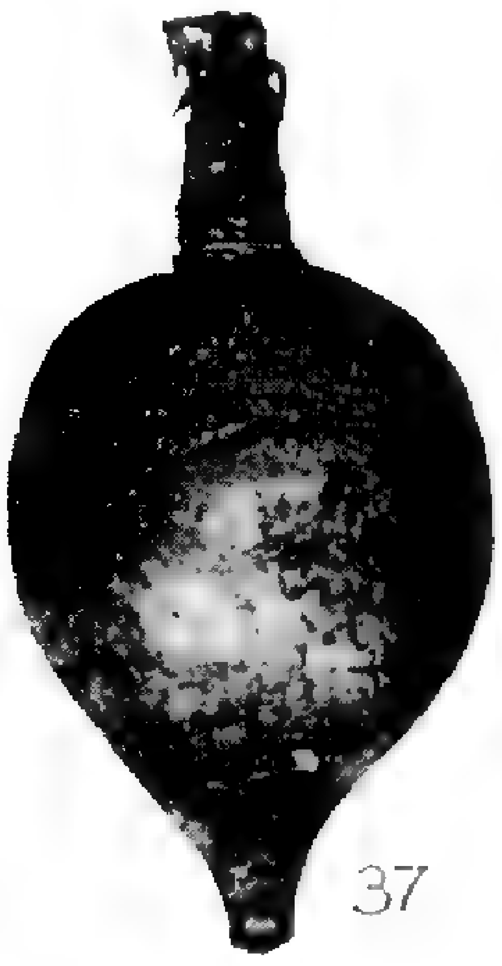
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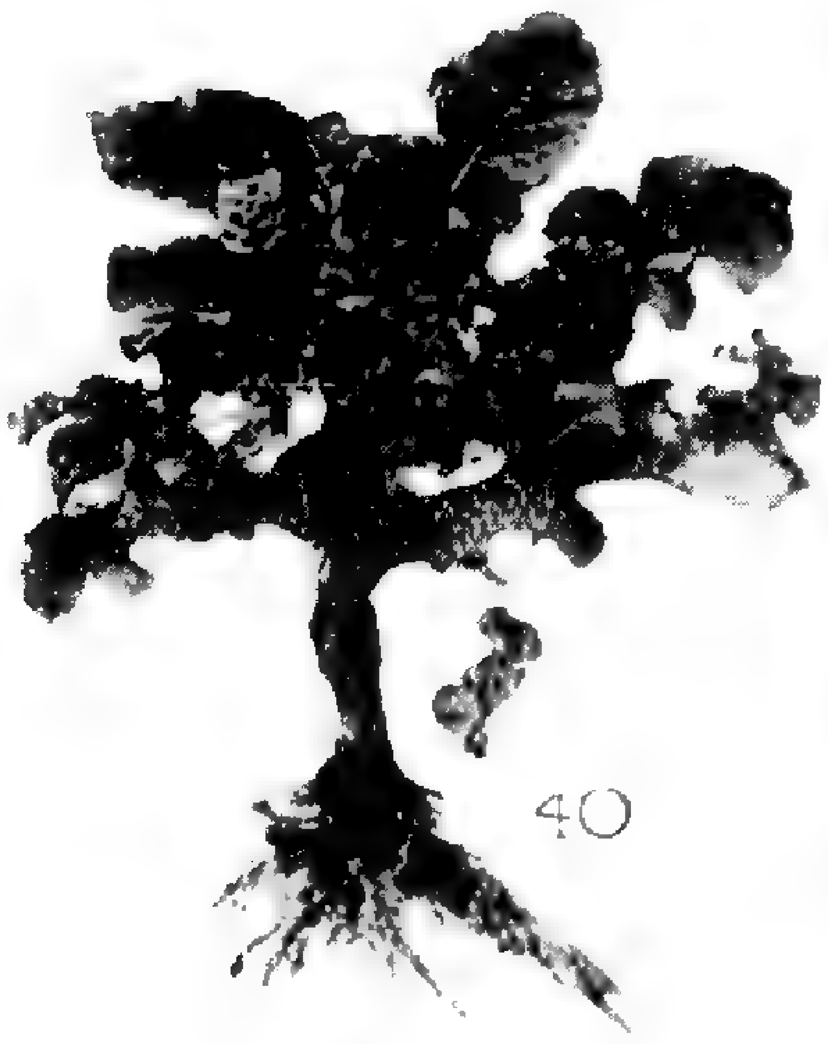
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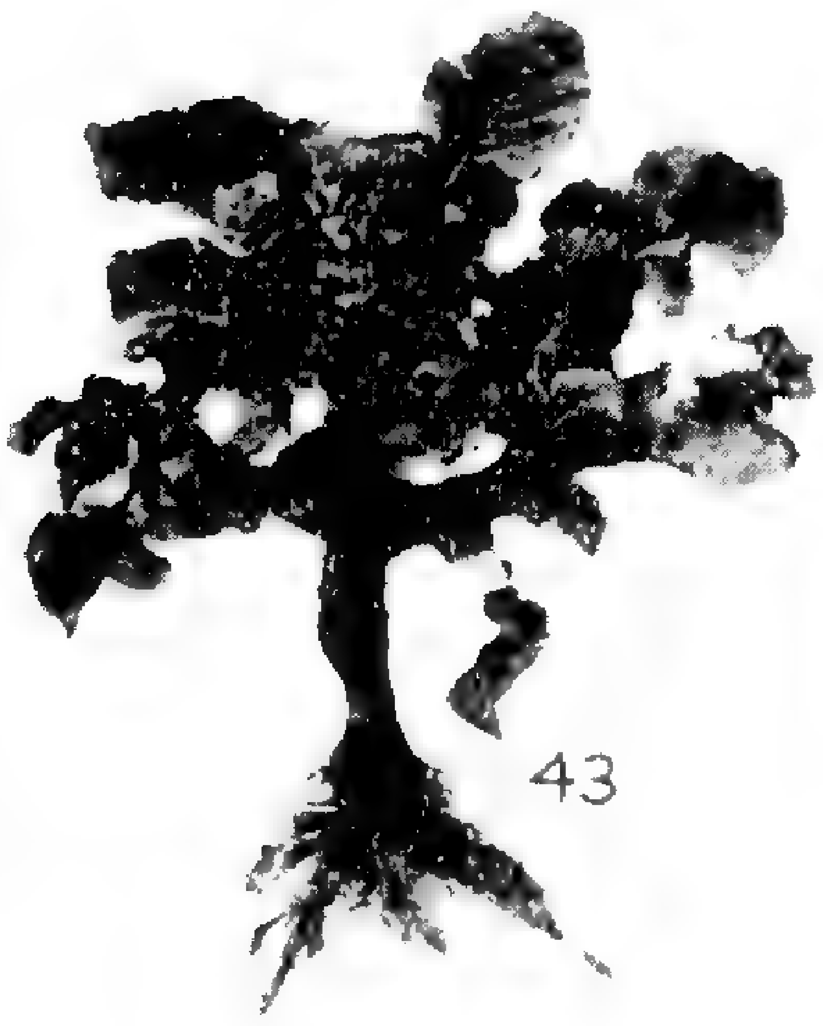
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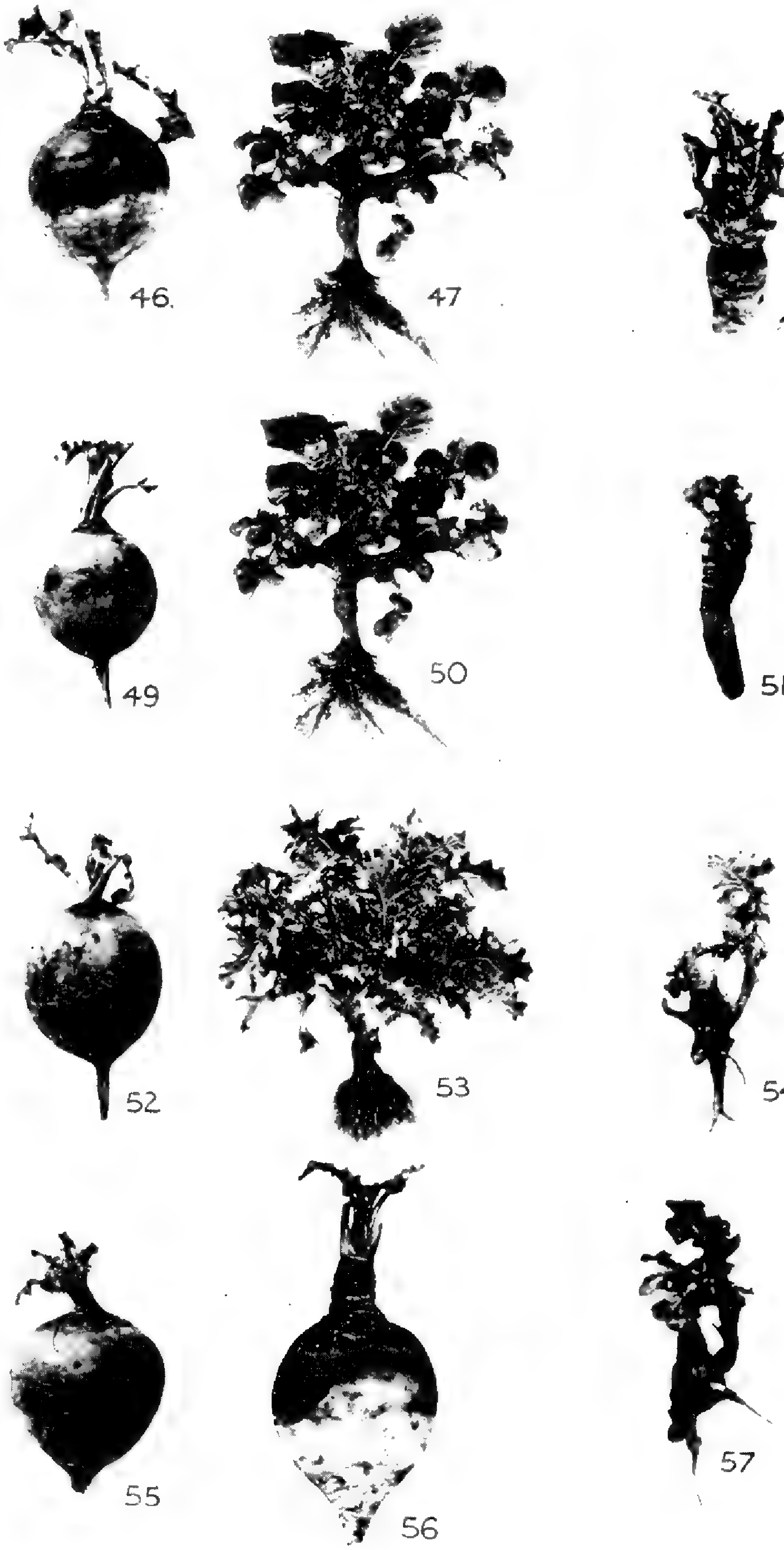

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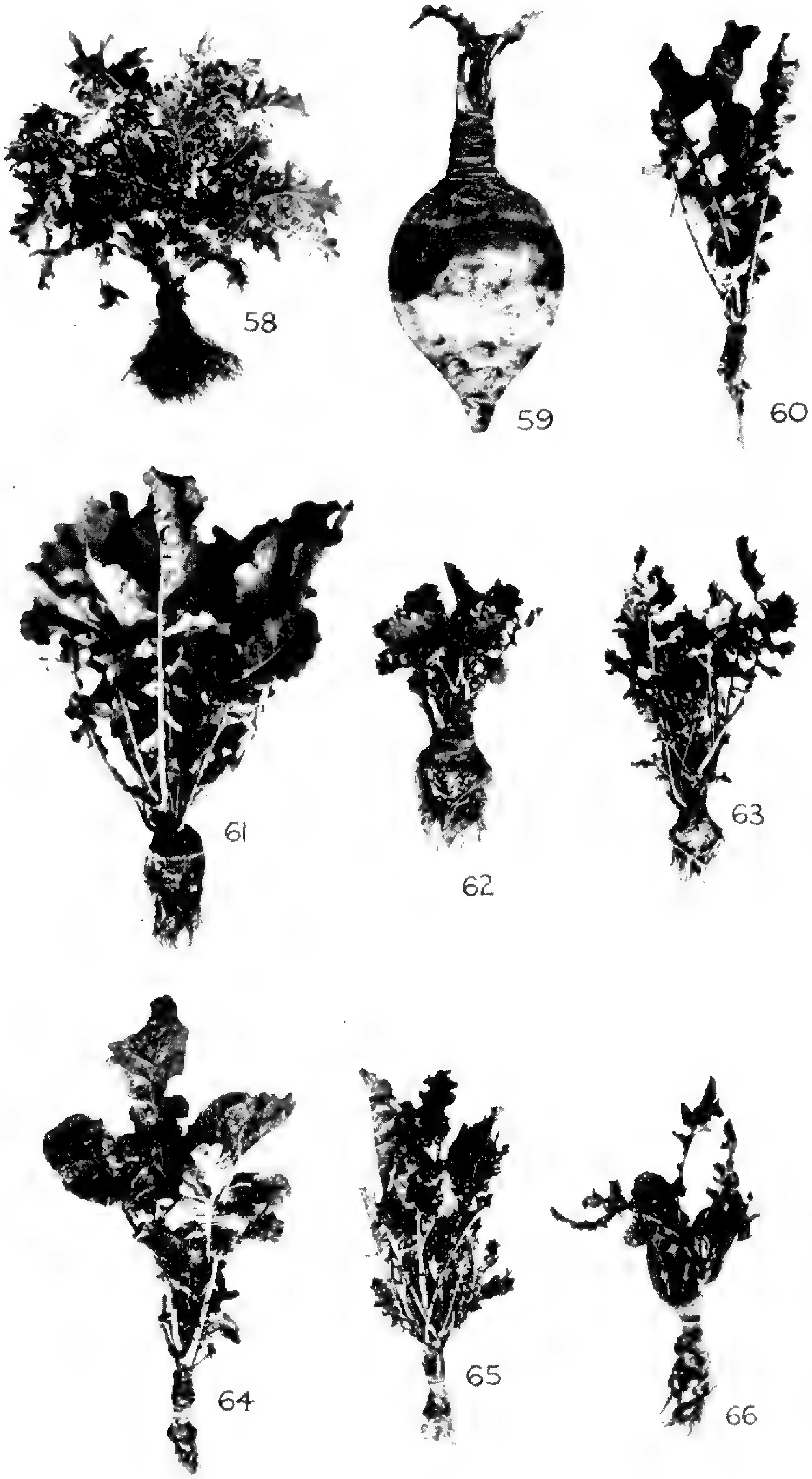

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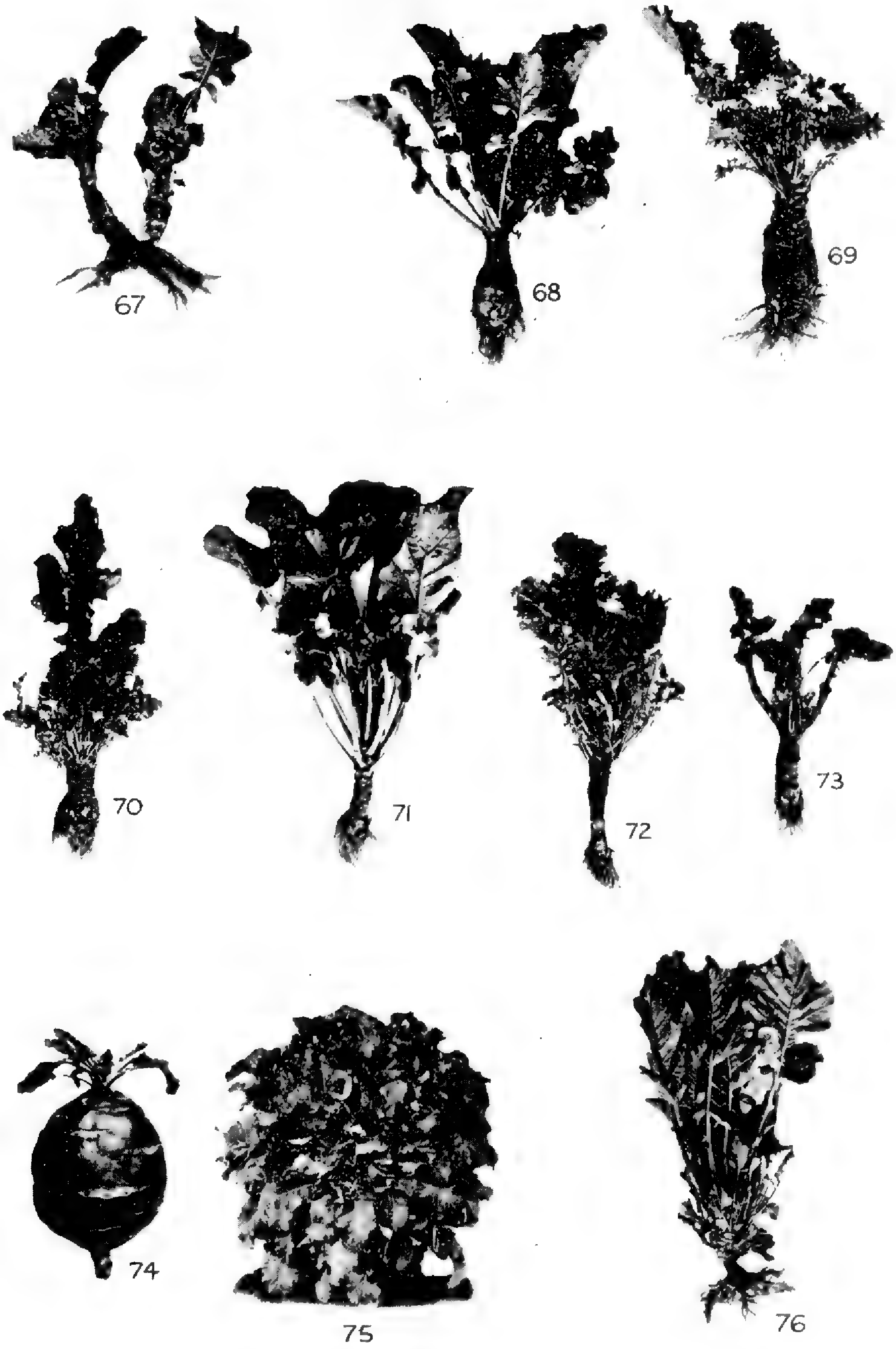

Grout, sc.

BRASSICA CROSSES.

Fig. 83. 28 were bulbless with Kohl Rabi foliage.
„ 84. 38 had broad Cabbage-like leaves with a bulbless elongated stem.

From the 9 : 3 × 3 : 1 Mendelian ratio, we should expect—

	From 208 plants.
Bulbed, Thousand-headed Kale foliage ...	117
„ Kohl Rabi foliage	39
Bulbless, Thousand-headed Kale foliage ...	39
„ Kohl Rabi foliage	13

♂ Kohl Rabi on ♀ Drumhead Cabbage (Pl. **33**. figs. 85 & 86).

The plants of F 1 in this cross had slight indication of the bulbing character with foliage resembling that of the Cabbage. There was, however, no sign of the "hearting" tendency of the Cabbage (fig. 87).

215 plants were raised of the F 2 generation (see figs. 88, 89, & 90). Of these :—

Fig. 88. 45 had distinct Kohl Rabi bulbs and foliage.
„ 89. 154 had rather enlarged stems, as if influenced by Kohl Rabi, the foliage being variable and undeterminate.
„ 90. Only 16 plants had leaves closely resembling those of the Cabbage.

As regards typical Kohl Rabi plants there were—

	Found (215 plants).	Expected (from 216 plants).
Kohl Rabi	45	54
Not Kohl Rabi	170	162

In the reciprocal cross :—

♂ Drumhead Cabbage on ♀ Kohl Rabi (see figs. 85 & 86),

the plants of F 1 were similar to those of F 1 in the reverse cross, having Cabbage-like leaves and a slight bulb (fig. 91).

195 plants were grown of the F 2 generation (see figs. 92, 93, 94, & 95, Pl. **34**). Of these—

Fig. 92. 46 were like Kohl Rabi (2 of these purple-leaved).
„ 93. 8 had leaves like Cabbage (6 of these purple).
„ 94. 140 had enlarged stems with foliage of variable character.
„ 95. 1 resembled a Kale with a "curled" or "fringed" leaf.

As regards typical Kohl Rabi plants there were—

	Found (195 plants).	Expected (from 196 plants).
Kohl Rabi	46	49
Not Kohl Rabi	149	147

♂ Thousand-headed Kale on ♀ Drumhead Cabbage (figs. 96 & 97).

The plants of F 1 resembled a coarse-leaved Thousand-headed Kale with little or no trace of the Cabbage parent. (No photo.)

In F 2, 204 plants were raised (figs. 98, 99, & 100). Of these :—

Fig. 98. 176 resembled a dwarf type of Thousand-headed Kale with leaves broader than usual and fewer branches.
,, 99. 26 resembled the Cabbage.
,, 100. 2 plants were much like Brussels Sprouts.

A few plants in F 2 had purple leaves.

♂ Swede (purple top, yellow-fleshed, Pl. **35**. fig. 101) on ♀ Asparagus Kale (fig. 102).

The plants of F 1 had foliage like Asparagus Kale and somewhat thickened stems (fig. 103).

208 plants of the F 2 generation were raised (figs. 104, 105, 106, & 107). Of these—

178 were more or less "bulbed,"	112 having	Swede foliage.	(Fig. 104)
	66 ,,	Asparagus Kale foliage.	(,, 105)
30 were bulbless,	14 ,,	Swede foliage.	(,, 106)
	16 ,,	Asparagus Kale foliage.	(,, 107)

Assuming that "bulbing" and "Swede foliage" were the dominant characters, the expected results would be—

156 bulbed	117 bulbed with Swede foliage.
	39 ,, ,, Asparagus Kale foliage.
52 bulbless	39 bulbless with Swede foliage.
	13 ,, ,, Asparagus Kale foliage.

N.B. The foliage of Asparagus Kale always dies off in the winter (see figs. 105 & 107).

Conclusions.

1. The races and varieties of *Brassica oleracea*, L., such as Cabbages, Kohl Rabi, and Thousand-headed Kale, cross readily, the resulting plants being of nondescript mongrel character, unlike the parents. It would appear that the special forms as at present met with in gardens are more the result of continued selection rather than the direct product of crossing.
2. Forms of *Brassica oleracea*, L. (all of which have smooth glaucous leaves in all stages of their growth), did not cross with those of Turnip

(*Brassica Rapa*, L.), Swede Turnips (*Brassica campestris*, L., var. *Napobrassica*, DC.), or various kinds of oil-yielding Rapes, all of which have hispid leaves when young.

3. No form of Rape was met with which had smooth leaves.
4. Rapes, Turnips, and Swedes cross readily with each other.

    The plants obtained by crossing the (hispid green-leaved) Turnip with the (hispid glaucous-leaved) Swede proved sterile.

    The Turnip and Swede-Turnip are no doubt specifically distinct.

    Ragged Jack Kale and Asparagus Kale produce fertile crosses with Swede. All have hispid glaucous leaves when young.
5. The so-called "Hybrid" yellow-fleshed Turnip cannot have been obtained by crossing the Swede with the Turnip.
6. The relationship between the white- and the yellow-fleshed forms, both of Turnips and Swedes, is still unsettled.
7. Several of the crosses and their progeny exhibit simple Mendelian phenomena, but there are many points connected with the occurrences of new features, such as novel colour and altered form of leaf, in the segregates of F 2, which are not clearly understood.

    The peculiar and apparently distinct character of "fleshiness" possessed by the seedsmen's specially selected forms of "roots" is very much reduced in the F 1 plants, and its occurrence in these may be readily confused with increased vigour of stem. It returns, however, in the F 2 generation in increased intensity, but none of these plants seem to possess it in the same degree as the original parents of the cross.

    In the crosses where the green Drumhead Cabbage was one of the parents, a few plants having purple foliage were met with in the F 2 generation.

In preparing this paper for publication in the Society's Journal, I have had the valued help of Professor Percival.

EXPLANATION OF THE PLATES.

Plate 24.

Fig. 1. Green Kale.
2. Variegated Kale.
3. Thousand-headed Kale.
4. Savoy.
5. Brussels Sprouts.
Fig. 6. Drumhead Field Cabbage.
7. Garden Cabbage.
8. Red Cabbage.
9. Couve Tronchuda.

Plate 25.

Fig. 10. A Brussels Sprouts plant with Cabbage head.
11. A new hardy curled form of Thousand-headed Kale.
12. A plant of the habit of Thousand-headed Kale, but having very white and tender leaf-stalks of the nature of Couve Tronchuda.
13. A heading or hearting form of Couve Tronchuda.
14. True Thousand-headed Kale (for comparison).
15. True Couve Tronchuda (for comparison).

PLATE 26.

Types of roots and plants used in the experiments (see page 338):—

Fig. 16. Colza Rape.
17. Ragged Jack Kale.
18. Asparagus Kale.
19. Kohl Rabi.

Fig. 20. Thousand-headed Kale.
21. Drumhead Cabbage.
Figs. 22–24. Swede Turnips.
25–27. Turnips.

PLATE 27.

Fig. 28. Asparagus Kale
on
29. Yellow-fleshed Swede.

30. Type of plant produced in F 1.

Fig. 31. White Turnip
on
32. Asparagus Kale.

33. Type of plant produced in F 1.

Fig. 34. Ragged Jack Kale
on
35. Yellow-fleshed Swede.

36. Type of plant produced in F 1.

PLATE 28.

Fig. 37. Yellow-fleshed Swede
on
38. Ragged Jack Kale.

39. Type of plant produced in F 1.

40. Colza Rape
on
41. Yellow-fleshed Swede.

42. Type of plant produced in F 1.

Fig. 43. Colza Rape
on
44. White-fleshed Swede.
45. Type of plant produced in F 1.

PLATE 29.

Fig. 46. White-fleshed Turnip
on
47. Colza Rape.

48. Type of plant produced in F 1.

Fig. 52. Yellow-fleshed Turnip
on
53. Ragged Jack Kale.

54. Type of plant produced in F 1.

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49. Yellow-fleshed Turnip
on
50. Colza Rape.

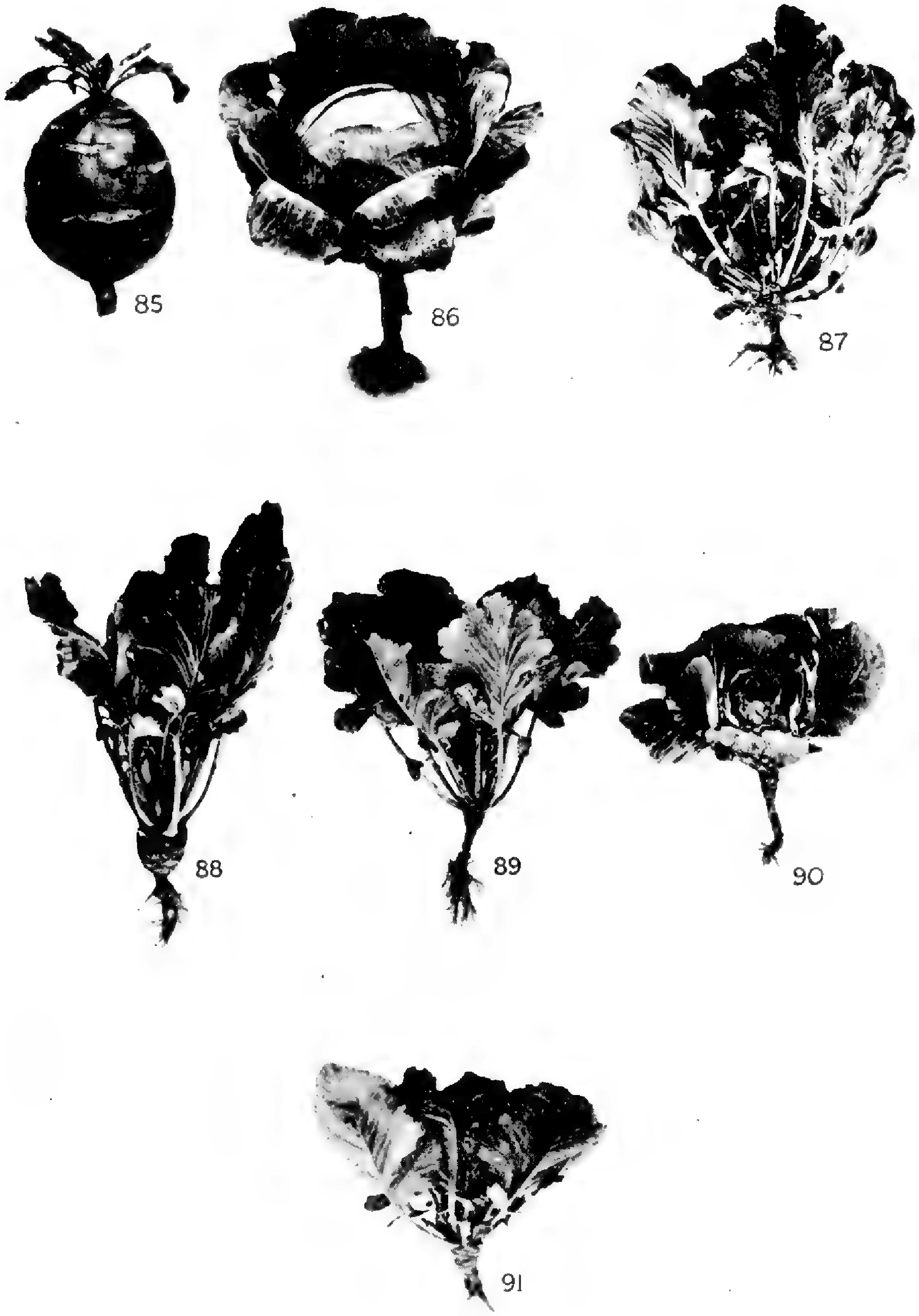
51. Type of plant produced in F 1.

55. White-fleshed Turnip
on
56. White Swede.

57. Type of plant produced in F 1.

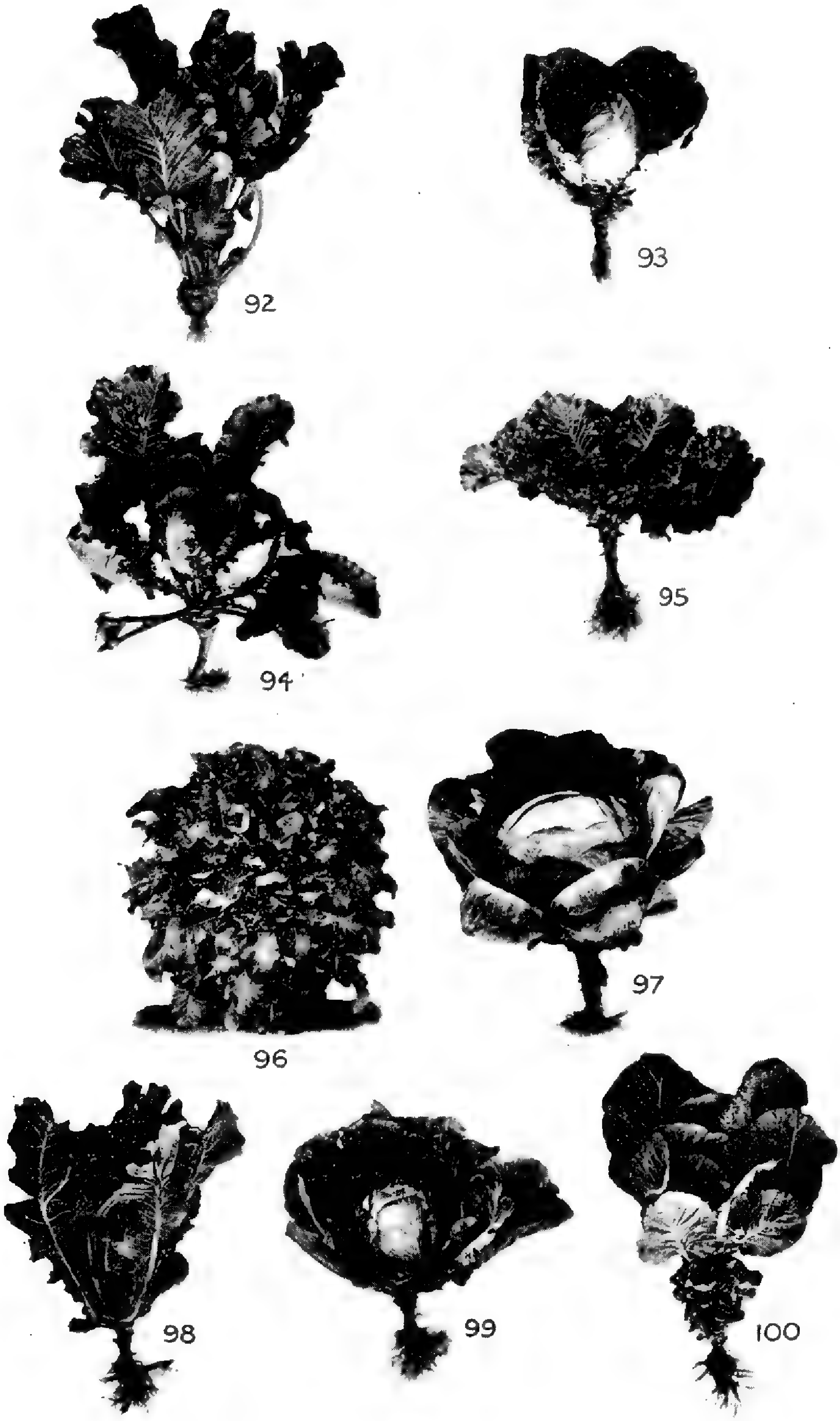
Grout, sc.

BRASSICA CROSSES.



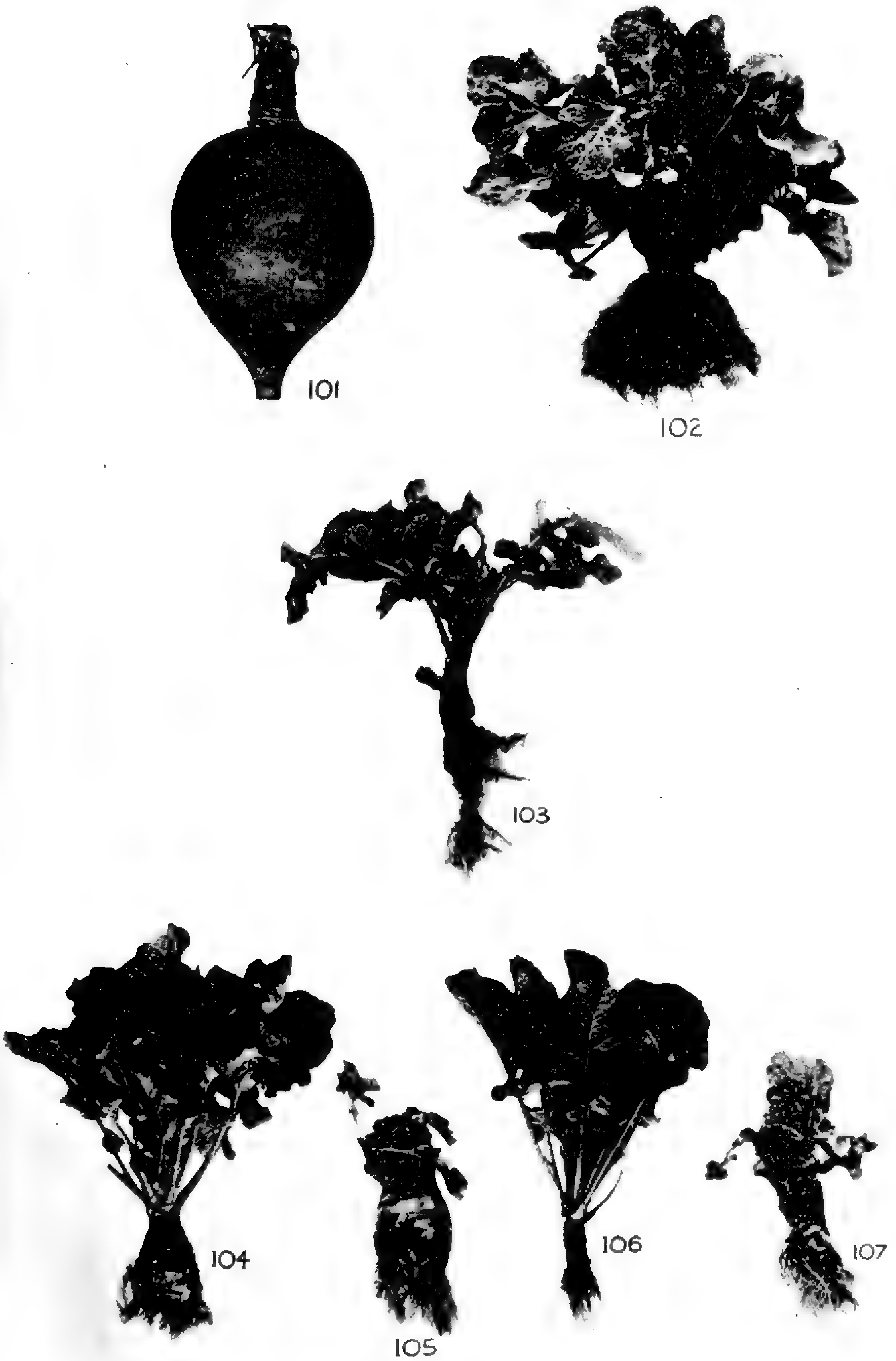
Grout, sc.

BRASSICA CROSSES.



Grout, sc.

BRASSICA CROSSES.



Grout, sc.

BRASSICA CROSSES.

PLATE 30.

Fig. 58. Ragged Jack Kale. ♂.
59. White-fleshed Swede. ♀.
60. Plant of F 1 generation of Ragged Jack Kale (♂) on White Swede (♀).
Figs. 61–66. Plants of F 2 generation.

PLATE 31.

Fig. 67. Plant of F 1 generation of White Swede (♂) on Ragged Jack Kale (♀).
Figs. 68–73. Plants of F 2 generation.
Fig. 74. Kohl Rabi (♂).
75. Thousand-headed Kale (♀).
76. Plant of F 1 generation of Kohl Rabi (♂) on Thousand-headed Kale (♀).

PLATE 32.

Figs. 77–79. Plants of F 2 generation of Kohl Rabi (♂) on Thousand-headed Kale (♀).
Fig. 80. Plant of F 1 generation of Thousand-headed Kale (♂) on Kohl Rabi (♀).
Figs. 81–84. Plants of F 2 generation.

PLATE 33.

Fig. 85. Kohl Rabi (♂).
86. Drumhead Cabbage (♀).
87. Plant of F 1 generation of Kohl Rabi (♂) on Drumhead Cabbage (♀).
Figs. 88–90. Plants of F 2 generation.
Fig. 91. Plant of F 1 generation of Drumhead Cabbage (♂) on Kohl Rabi (♀).

PLATE 34.

Figs. 92–95. Plants of F 2 generation of Drumhead Cabbage (♂) on Kohl Rabi (♀).
Fig. 96. Thousand-headed Kale (♂).
97. Drumhead Cabbage (♀).
Figs. 98–100. Plants of F 2 generation of Thousand-headed Kale (♂) on Drumhead Cabbage (♀).

PLATE 35.

Fig. 101. Purple-top Swede (♂).
102. Asparagus Kale (♀).
103. Plant of F 1 generation of Purple-top Swede (♂) on Asparagus Kale (♀).
Figs. 104–107. Plants of F 2 generation.

A Botanical Expedition to Central Fokien. By S. T. DUNN, B.A., F.L.S., Superintendent, Botanical and Forestry Department, Hongkong.

[Read 6th February, 1908.]

THE little explored and romantic Province of Fokien lies on the coast of China just to the north of the tropics half way between Hongkong and Shanghai. In area it is about equal to England and Wales combined. A large portion of its surface is traversed by ranges of mountains fairly covered in some parts with old forest and intersected by the deep river gorges which characterize the south-east regions of China and give to that part of the country the wild and picturesque scenery for which it is famous.

Up to the time of the expedition of which this paper gives a short account, there is no record that the interior of this district had ever been visited by a botanist. It had several times been crossed by travellers; Marco Polo himself undoubtedly descended the Kienning River and the Min River in the 13th century, thus traversing the centre of the province, and in recent times Mr. De La Touche, the ornithologist, ascended the same rivers in search of birds, and incidentally made a small but very interesting collection of plants, which he sent to Franchet at Paris, where they were described (Bull. Soc. Bot. France, xlvi. 204). Numerous small collections have been made from time to time in the more accessible country round the treaty ports of Foochow and Amoy; and the following three expeditions towards the interior are also on record. In 1849 Fortune attempted to ascend the Min River from Foochow, but at Shui Kau, 80 miles from that city, turned back from want of funds: later in the same year he traversed the north corner of the province. In 1873 David penetrated into the high border mountains south-west of the Bohea Hills; his collections in that country proved of great interest and many novelties were published by Franchet. Whether Fortune collected plants on his two Fokien expeditions it is difficult to say with certainty, as few of his specimens are precisely located, but several of those in the Kew Herbarium agree so closely with others from Central Fokien that I am inclined to think that he did so.

In 1905, being impressed with the importance of attempting to visit and explore this large area, the flora of which was almost totally unknown and very poorly represented in herbaria, and was supposed moreover to comprise numerous plants of first-rate commercial importance, I proposed to the Government of Hongkong that I should be given two months' leave of absence and the services of three native collectors, with the object of exploring the central portion of Fokien.

This being arranged, we accordingly started from Hongkong in the middle of April 1905 for Foochow by sea. My object was to make an

exhaustive collection of all the species of flowering plants and cryptogams recognizable in late spring and early summer, and to preserve all but the commonest species in quadruplicate for purposes of distribution. With this object in view, I determined to take as much drying paper as could possibly be wanted for making a large collection, to take an extra man from the colonial herbarium expressly for managing the drying presses, and to keep throughout within touch of rivers, the only routes on which this heavy outfit could be easily transported. Foochow was reached on April 25th, and eleven days were spent in collecting on the plains and lower hills round the city. The banks of the Yuen Fu River were also explored up to about 30 miles from its junction with the Min. At this point lies the large island of Nantai, on which Foochow is partly built. The narrow rocky gorges which run up from the Yuen Fu, and the extensive bamboo groves which clothe the lower hills along its course proved most interesting collecting grounds, and yielded several new or otherwise interesting species.

On the evening of May 4th we started up the main stream of the Min, and in two days reached the lower end of the rapids at Shui Kau (mouth of the waters). From this point the Min is barred by an almost unbroken succession of more or less dangerous rapids as far as Yenping, a distance of 50 miles in the direct line, or about double that distance by river.

The passage of the rapids in either direction is expensive and difficult, and this, in an almost roadless country, has doubtless contributed to the scarcity of the information, both botanical and otherwise, which has reached us from the interior.

Up to this time the weather had been fine and most favourable for our purpose, and, although a few wet spells were encountered during our stay in the interior, they were never long enough seriously to hamper our work.

A day was spent in exploring the valleys near Shui Kau, along Tap Ling Ho, and several interesting plants were found among the extensive Tea-oil plantations which here cover nearly all the low-lying hills ; the little known *Actinidia lanata* was as common as the blackberry is in England, and groves of the rare *Machilus Grijsii,* just then in full fruit, made fine pieces of colour owing to the vivid scarlet of their peduncles. As the rapids were ascended the country, which had at first been open and cultivated, became enclosed by high mountains. 200 more species from the banks of the Min were added to our presses, which now contained about 700 species or some 2000 specimens. Yenping was reached on the 13th of May : here we were fortunate enough to meet Dr. Skinner of the American Mission, who lent us a room in which to store our belongings, and I determined to make this the base for future work. As we could see from the river that high mountains, densely covered in some parts with forests, stood within reach of the city, this neighbourhood seemed a suitable one in which to occupy the 3 or 4 weeks which still

remained, particularly as it lay near the centre of the province and far from any previously explored parts.

Before moving from the town the previous collections were carefully sorted and a rough key drawn up for each genus represented. This work was greatly facilitated by a method which had been adopted of laying each plant in the presses on a sheet of paper provided with a projecting tag bearing the proper ordinal and the generic numbers, so that any desired genus could be easily found without opening all the presses.

Although this occupied several days they were well spent, and the key proved of the greatest value in distinguishing new forms from those already collected, especially in such critical genera as *Eurya*, *Actinidia* or *Carex*, where it is difficult to carry in the memory while in the field, specific differences which may be obvious enough when the plants are laid side by side in the herbarium. This key was kept up to date by the addition of new species as they were subsequently found.

I then sent two collectors up to Shao Wu in the west of the province and left one man in charge of our base, while I, with my wife, who accompanied me throughout, and one collector, took up our quarters in a new Chinese cottage (any one who has travelled in China will understand the necessity of finding a house, previously uninhabited by Chinese peasants) in the small hamlet of Buong Kang, about half a day's march from Yenping, and in the centre of one of the largest patches of virgin forest on the Yenping mountains.

The forest is traversed by the high road from Yenping to Yenkau, which here runs up a valley by a flight of several thousand rough stone steps leading high above the village to a pass known as Sang Chien Bah Beh Kang or pass of 3800 steps. The valley in its lower part is clothed with dense woods with occasional clearings for bamboo and other cultivation, but, half way up, the rocks close in on both sides and make a narrow mouth through which the stream pours in a series of cascades far below the road, while the cliffs tower up several hundred feet above it. It is just above this romantic spot that Buong Kang is situated. Above the hamlet the road is bordered nearly to the top with huge trees of Liquidambar, Chestnut, Camphor, and Photinia.

During the three weeks spent here I succeeded in penetrating to all parts of the lower and middle forest, though in some places the almost impenetrable undergrowth and in others frequent precipices rendered the work slow; in some of the thickest portions torrent beds afforded the only means of progress, and it was along the banks of these, under the shade of overarching trees, that some of the most interesting species were found. A few days sufficed for the exploration of the grassy downs above the level of the woods. Each day's collections were sent down in the evening to be dried at Yenping and the species added to the key. In this way the number of distinguishable species

was brought up to 1443, including such of those gathered by the collectors from Shao Wu as were additional to my own collections.

The opportunity was taken of making careful notes on some of the local industries, such as paper-making, wood-oil manufacture, and the utilization of the different kinds of bamboos. An interesting day was spent in visiting the garden of Lei Kam, Literary Mandarin of Yenping, with whom Dr. Skinner is on friendly terms. The garden contained a great variety of trees and shrubs, as well as the usual plants in pots, which form the chief feature of all Chinese gardens. Two of the trees, both Michelias, which were unfamiliar to me, and of which I took specimens, prove to be new to science.

On the 23rd of June the collections were packed and brought back to Hongkong after a most successful expedition of nearly two months.

The specimens contain types of at least 40 new species, and numerous other interesting plants are among them, additional to the flora of the province, and even, in some cases, to that of China.

I wish to acknowledge my indebtedness to the great resources of the Kew Herbarium and Library for the details required in compiling this paper, and to the courtesy of the Director for allowing me free use of them.

In the following list all the novelties so far identified are described, with the exception of the Hamamelidaceæ. These by Mr. Hemsley's request have been handed to him for description in Hooker's 'Icones Plantarum.' Besides the new species and varieties, only such records are included below as are thought to be of special interest.

ENUMERATION AND DESCRIPTIONS OF NEW SPECIES.

MAGNOLIACEÆ.

MICHELIA MAUDIÆ, *Dunn*, sp. n.

Arbor parva, pulchra. Ramulorum cortex læte brunneus, cum tota planta glaberrimus. Folia oblonga vel ovato-oblonga, 10–17 cm. longa, 4–7 cm. lata, coriacea, subtus glaucescentia, obtuse acuminata, basi acuta, venis lateralibus 8–12 paribus, venulis utrinque conspicue reticulatis, petiolis 25–30 mm. longis. Flores fragrantes, solitarii, in axillis foliorum summorum evoluti ; sepala decidua non visa ; petala alba, ovata, 5–6 cm. longa, obtusa ; stamina petalis 5–6-plo breviora, antheris filamento crasso 5-plo longioribus ; gynæcium, petalis nuper lapsis, 20 mm. longum, gynophorum 10 mm. longum includens. Gynophorum et pars fertilis fructus maturitate incipiente fortiter elongatæ.

Yenping, cultivated in the garden of the Chinese Literary Mandarin, Hongkong Herb. 2449. Kwantung, Fung Wong Shan, near Hongkong, Hongkong Herb. 2065.

The species is named after my wife, who has been my constant companion during my explorations in Fokien and in other parts of China.

Michelia Skinneriana, *Dunn*, sp. n.

Arbor magna. Ramuli cupreo-sericei, mox glabri. Folia subsessilia, lanceolata, 6–10 cm. longa, 25–30 mm. lata, chartacea, matura superne glabra, nitentia, subtus tenuiter sericea, caudata, basi acuta, costa superne impressa, venis lateralibus 8–10 paribus, venulis obscure reticulatis. Flores flavi, axillares, solitarii, pedunculis rubro-sericeis 6–8 mm. longis ; sepala ovata, dense sericea ; petala ovata 18–20 mm. longa, cerea, glabra, apice rotundata ; stamina 5–6 mm. longa, antheris filamento 3-plo longioribus ; ovaria dense pubescentia.

Yenping, cultivated in the gardens of the Chinese Literary Mandarin. Hongkong Herb. 2448.

The tree is closely allied to *M. fusca*, though readily distinguished, even at a distance, by its leaves. The specific name commemorates the chief of the American mission in Yenping, to whose kindness I was indebted for the opportunity of visiting this interesting garden in the city, as well as for numerous other hospitable actions.

Schizandra elongata, *Hook. f.*, var. longissima, *Dunn*, var. n. Pedunculi statu fructifero 7–9 cm. longi ; flores 15–20 mm. diam.

Glades in the woods and along the sides of streams near Buong Kang at 2000 ft. Hongkong Herb. 2441, 2442. Yunnan, *Henry*, 9193 A, 9193 B.

CRUCIFERÆ.

Nasturtium rivulorum, *Dunn*, sp. n.

Herba annua, laxe procumbens, omnino glabra. Folia trifoliolata, radicalium petiolis 5–6 cm. longis, superiorum gradatim brevioribus ; inferiorum foliola ovata, 3–5 cm. longa, papyracea, sinuata, venis excurrentibus, obtusa, basi cordata ; superiorum foliola similia sed magis sinuata, brevius petiolulata. Racemi axillares, folia sæpe excedentes ; pedunculi bracteis 1–2 ovatis cordatis stipitatis prope apicem instructi, 4–6 cm. longi. Flores parvi, albi, approximati ; sepala, petala et stamina 1½–2 mm. longa ; ovarium ovatum, complanatum, stylo simplice, ovario 3-plo breviore, stigmate globoso ; ovula circiter 12, dissepimento obsoleto biserialia. Fructus ignotus.

Along the mossy banks of rivulets in shady woods at Fong Kong Tze near Foochow. Hongkong Herb. 2354.

Cochlearia fumarioides, *Dunn*, sp. n.

Herba annua, gracillima, humifusa, glabra. Folia trifoliolata, 1–2 cm. longa, petiolis 5–10 mm. longis; foliola ovata, sinuata, sæpe triloba, membranacea, obtusa, petiolulis 5 mm. longis. Racemi axillares terminalesque, fructu elongati, ad 6 cm. longi, sessiles. Flores minuti, $\frac{1}{2}$–1 mm. longi; ovarium 1-loculare; ovula 1–2, apicalia. Silicula orbicularis, compressa, dense pustulata, 2 mm. longa, valvis deciduis; semen unicum; radicula incumbens.

On wet vertical rocks in the forest near Buong Kang. Hongkong Herb. 2360.

This interesting little species differs widely from most Cochlearias in habit and from all in its blistered fruit, but the divergence does not appear sufficient foundation for a new genus.

TERNSTRŒMIACEÆ.

Eurya Loquaiana, *Dunn*, sp. n.

Frutex 3 m. altus, præter alabastra omnino glaber. Ramuli cylindrici. Folia lanceolata, præter basin scite serrata, 4–6 cm. longa, 15–20 mm. lata, chartacea, obtuse acuminata, basi cuneata, costa superne impressa, subtus prominente, venis secundariis ascendentibus frequentibus obscuris, petiolis 3 mm. longis. Flores in foliorum vetustiorum et delapsorum axillis 1–3-natim fasciculati; sepala ovata, obtusa, 1–1$\frac{1}{2}$ mm. longa; petala staminaque ignota; capsula ovalis, 3 mm. longa, 3-locularis; stylus capsulam æquans, tripartitus, ramis basi duplo longioribus.

In woods on the mountain-sides near Yenping at 2300 ft. Hongkong Herb. 2395. Collected by Lo Quai. This shrub has a resemblance to *E. japonica*, var. *nitida*, Hook. f. & Thoms., but can be distinguished by its small fruit and long branched styles.

Actinidia lanata, *Hemsl.*

Among the tea-oil plantations and on open rocky hillsides near the Min at Shui Kau. Hongkong Herb. 2397.

This species was previously known to science only from a single fruiting specimen from the N.W. River in Kwantung. It is a striking shrub forming large straggling bushes similar to those of *Rubus rusticanus*. The flowers are 2–3 cm. across with round salmon-pink petals, longer than the numerous stamens (in the male flowers).

Actinidia Hemsleyana, *Dunn*, sp. n.

Frutex vagans, caulibus dimorphis. Alteri longi, cito evoluti, primo dense

rufo-hispidi, tandem exigue setosi, alteri laterales, breves, tenuiter strigulosi vel hispiduli. Alabastra supra callos annulares foliorum delapsorum longe aureo-barbata. Folia oblongo-ovata, adpresse serrata, 10–20 cm. longa, 4–6 cm. lata, chartacea, præter petiolum sparse hispidum 2–3 cm. longum glabra. Cymæ axillares, sub-3-floræ, petiolis breviores. Flores viriduli ; masculorum sepala 5, ovata, subacuta, 5 mm. longa, dense rufo-tomentosa ; petala 5, glabra, obovata, apice rotundata, 10 mm. longa, staminibus fuscis sesquilongiora ; ovarii rudimentum 2 mm. latum, tomentosum, pedunculis gracilibus tomentosis ; fœminei similes sed sepala basi coalita, lobis ovatis obtusis, 8 mm. longa ; stamina rudimentaria ; ovarium depresso-globosum, 6 mm. latum. Fructus immaturus cylindricus, 10 mm. longus, 5 mm. latus, apice rotundatus, stylis plurimis coronatus ; styli 4 mm. longi.

Yenping Mountains, in the upper valleys. Hongkong Herb. 2400.

This beautiful and interesting plant is dedicated to Mr. W. Botting Hemsley, F.R.S., the distinguished keeper of the Kew Herbarium, whose instruction and kindness I gratefully acknowledge. The habit of this plant and all the other Actinidias that I have seen recalls that of *Rubus*, that is to say, they form large straggling bushes among rocks and undergrowth, in woods or in hedges. When occasion permits they may form real climbers, but I have not seen them in this condition. The present case gives a good example of the usual method of growth, and an account of it will elucidate some of the apparent anomalies of the specimens which have hitherto been received in herbaria. Each new extension of the shrub begins in this case with a long, arching, densely strigose tawny shoot bearing abnormal narrow leaves. In the autumn these leaves fall, leaving large thickened leaf-scars and a bud above each, protected by a tuft of stiff yellow hairs. These buds develop in the spring into short flower- and leaf-bearing shoots, the leaves and the indumentum being quite different to those of the primary shoots. The plant thus has, and so have also many other members of the genus, dimorphic stems, leaves, and flowers. The male and female bushes are, so far as I have seen, similar in their vegetative portions.

Actinidia lanceolata, *Dunn*, sp. n.

Frutex magnus, vagans, semi-scandens. Caules vetusti nigri, glabri, lenticellati ; ramuli florigeri dense cinnamomeo-puberuli. Folia lanceolata, mucronato-serrata, 5–7 cm. longa, 2–3 cm. lata, papyracea, supra sparse et minute puberula, subtus breviter albo-tomentosa, acuminata, basi cuneata, venis utrinque 4–5 arcuato-ascendentibus, petiolis 1–1½ cm. longis cum venis majoribus cinnamomeo-pubescentibus. Flores 3–6-ni, in cymas sæpius umbelliformes axillares pedunculatas dispositi, pedunculis 3–6 mm. longis cum pedicellis calycibusque tenuiter cinnamomeo-puberulis, bracteis linearibus, minutis ; sepala 5, rotundata, 3–4 mm. longa ; petala viridula, oblonga, acuta, vel rotundata, sepalis paullo longiora ; masculorum stamina lutea,

indefinita, sepalis æquilonga ; ovarii rudimentum oblongum, 1 mm. longum, tomentosum ; fœmineorum ovarium ad petalorum delapsum $1\frac{1}{2}$ mm. longum, ovale, acuminatum, rufo-tomentosum, stylis circiter 10 ovario longioribus. Fructus ignotus.

Hedges along the river banks at Yenping and at Wong Ka Chi, W. Fokien. Hongkong Herb. 2399.

ACTINIDIA SABIÆFOLIA, *Dunn*, sp. n.

Frutex scandens vel vagans, præter flores omnino glaber. Caules rubri, ad exitum ramorum fortiter callosi. Folia ovata, obscure crenata, sinubus mucronulo notatis, 5–6 cm. longa, papyracea, infra pallida, venulis rubris reticulata, acuta vel obtusa, basi rotundata, venis secundariis utrinque 5 immersis arcuato-ascendentibus, petiolis 2 cm. longis. Cymæ axillares, sub-3-floræ, petiolos æquantes, bracteis minutis. Flores masculi sepala rotundata 2–3 mm. longa, utrinque tenuiter pilosa ; petala alba, obovata, apice rotundata, 5–6 mm. longa, staminibus luteis duplo longiora ; ovarii rudimentum globulare, rubro-tomentosum.

Wood-borders and glades on the mountain slopes near Yenping. Hongkong Herb. 2402. Resembling *A. melanandra*, Franch., but distinguished by the shape of its leaves and by its yellow anthers.

CAMELLIA EDITHÆ, *Hance*. This rare shrub is now for the third time recorded from this single province. Hongkong Herb. 2455.

POLYGALACEÆ.

POLYGALA LATOUCHEI, *Finet et Franch.* This plant was found several times about springs on the summits of the Yenping Mountains at perhaps 4500 ft. (Hongkong Herb. 2372.) It shares with the Yunnanese *P. saxicola*, Dunn, alone in the genus the character of having fleshy stems and peduncles.

CELASTRACEÆ.

MICROTROPIS FOKIENENSIS, *Dunn*, sp. n.

Frutex 3 m. altus, omnino glaber. Ramuli angulati. Folia opposita, oblanceolata, integra, 5–6 cm. longa, acuta, basi longe cuneata, petiolo 4 mm. longo. Cymæ axillares, 1–2-næ, paucifloræ, decurvæ, 1 cm. longæ, bracteis multis triangularibus imbricatis vestitæ. Flores inter bracteas sessiles ; sepala 4, rotundata, $1\frac{1}{2}$ mm. longa, late imbricata ; stamina 4, in disco disposita, sepalis breviora. Fructus juvenis 2–3 mm. longus, ovatus acuminatus, stylo $\frac{1}{2}$–1 mm. longo ; stigma quadrilobum.

Yenping heights at 5000 ft. Hongkong Herb. 2394.

SAPINDACEÆ.

ACER WILSONI, *Rehder*, var. SERRULATA, *Dunn*, var. n. Folia serrulata.

A small tree on the sides of the tributary gorges of the Yuen Fu River near Foochow. Hongkong Herb. 2545.

SABIACEÆ.

SABIA DISCOLOR, *Dunn*, sp. n.

Frutex scandens vel vagans, glaber. Ramuli fusci. Folia late ovata, integra, anguste revoluta, 4–6 cm. longa, papyracea, supra in siccitate nigrescentia, subtus glauca, obtusa, acuta vel leviter acuminata, basi rotundata, venis secondariis utrinque 3–4 duobus utrinque basi approximatis supra et infra leviter prominulis, petiolis 7–10 mm. longis. Cymæ pseudo-umbellatæ, 2–5-floræ, pedicellatæ, axillares, ebracteatæ, pedunculis 10–12 mm. longis. Flores virides, præcoces ; sepala lanceolata, $\frac{1}{2}$–1 mm. longa ; petala ovata, 2 mm. longa, staminibus duplo longiora, stylum æquantia. Drupæ in siccitate compressæ, corrugatæ, 6 mm. latæ ; pedunculis 3 cm. longis.

Bushy mountain-sides near Yenping at 2300 ft. Hongkong Herb. 2537. Kuliang, Foochow. Hongkong Herb. 2536. This species differs from *S. japonica*, Max., its nearest ally, in its revolute leaves which are glaucous beneath.

MELIOSMA MYRIACANTHUM, *Sieb. & Zucc.*, var. DISCOLOR, *Dunn*, var. n. Folia subtus breviter tomentosa.

W. Fokien at Shao Wu. Hongkong Herb. 2536, 2537.

MELIOSMA RIGIDA, *Sieb. & Zucc.* Hongkong Herb. 2532. This record forms one more link in the distribution of the species between India and Japan ; it was previously known from Formosa and the Liu Chiu Islands, as well as from these extreme points.

ANACARDIACEÆ.

RHUS SYLVESTRIS, *Sieb. & Zucc.* Hongkong Herb. 2528. A southern extension of the known specific area.

LEGUMINOSÆ.

MILLETTIA PACHYCARPA, *Benth.* Hongkong Herb. 2564. Only previously from Yunnan.

SOPHORA FRANCHETIANA, *Dunn*, sp. n.

Frutex 1 m. altus. Ramuli, foliorum rachides, petioli, calyces pedunculique breviter fulvo-tomentosi. Folia pinnata, 10–14 cm. longa ; foliola sæpe 11, elliptica, 3–4 cm. longa, papyracea, supra glabra, costa impressa, subtus

molliter fulvo-pubescentia, acuta, basi rotundata vel obtuse cuneata, venis obscuris, petiolis 2–3 mm. longis. Racemi terminales, 6–7 cm. longi, bracteis minutis. Flores albi, pedicellis 4–5 mm. longis ; calycis tubus brevis, basi concava, 4 mm. latus, 3 mm. longus, lobis obscuris late triangularibus ; vexillum erectum, obovatum, apice retusum, 7 mm. longum ; alæ carinaque vexillo æquilongæ ; stamina libera, basi puberula ; ovarium pubescens ; ovula 4 in medio ovarii linearis disposita. Legumen (unum tantum visum) 3 cm. longum, in medio seminiferum ; utrinque angustatum, glabrum, opacum, brunneum ; semen unicum, magnum, ovale, luteum, nitens, 8 mm. longum.

Bamboo groves on the banks of the Yuen Fu River near Foochow. Hongkong Herb. 2582. Distinguished among the soft-leaved Sophoras by its broad calyx.

The trivial name commemorates the great French botanist who, among his numerous other works on the flora of China, has added to our knowledge of Fokien plants in a paper upon a collection made in that province by Mr. De La Touche of the C. I. M. C.

ROSACEÆ.

Rubus trifidus, *Thunb.* Hongkong Herb. No. 2626. Previously known only from the Corean Archipelago.

Rubus pectinellus, *Maxim.* Hongkong Herb. 2631. A Japanese bramble, now recorded for the first time from China.

Spiræa Blumei, *G. Don*, var. Maximowiczii, *Dunn.* *S. Maximowiczii*, Schneider, Laubholtz, i. 461. With the abundant material before me I find it impossible to separate this form specifically from the type. It seems to be rather a geographical variety at the south of the total area. Min Bank, Fokien, Hongkong Herb. 2674 ; Kwantung, *Ford*, 66 ; Ichang, Hupeh, *Henry*, 3506, 4115.

Spiræa prunifolia, *Sieb. & Zucc.*, var. integrifolia, *Dunn*, var. n. Folia integra.

Banks of the Yuen Fu River near Foochow. Hongkong Herb. 2658 ; also *De Grijs*, *Hance*, 1218.

HAMAMELIDACEÆ.

Distylium myricoides, *Hemsl. in Hook. Ic.* sub t. 2835, p. 2. Fokien, *Dunn*, 2684, 2685.

Distylium strictum, *Hemsl. l. c.* p. 3. Fokien, *Dunn*, 2681.

Sycopsis Dunnii, *Hemsl. l. c.* t. 2836. Min banks below Yenping. Hongkong Herb. 533, 2695.

Altingia gracilipes, *Hemsl. in Hook. Ic.* t. 2837. Yenping Mountains, western portion. Hongkong Herb. 119, 2682.

MELASTOMACEÆ.

Melastoma intermedia, *Dunn*, sp. n.

Frutex parvus. Ramuli angulati, sparse adpresse hispidi. Folia opposita, elliptica, integra, margine revoluto, 3–5 cm. longa, chartacea, supra in marginibus crebre in cætera superficie tenuiter adpresse hispida vel glabra, subtus pallidiora, in venis setosa, apice obtusa, basi rotundata vel obtuse cuneata, venis 5 a basi radiantibus, lateralibus marginalibus, petiolis 5–10 mm. longis. Flores solitarii, axillares vel terminales, ad ramulorum apices approximati, vel paniculam paucifloram terminalem formantes, pedunculis 1 cm. longis, bracteis 2 lanceolatis 6 mm. longis setosis prope apicem instructis; calycis tubus sphæricus, 6 mm. longus, cum lobis pedunculoque setis ascendentibus vestitus; lobi 5, lanceolati, acuti, tubo æquilongi, lobulis setaceis 3 mm. longis alternantibus; petala 5, rosea, obovata, 2 cm. longa; stamina generis. Fructus immaturus globosus, annulo coronatus.

Yenping Mountains at 4500 ft. Hongkong Herb. 2706.

The species is intermediate between *M. repens*, Desr., and *M. sanguinea*, Sims.

Phyllagathis chinensis, *Dunn*, sp. n.

Herba annua, 10–15 cm. alta. Caulis erectus, glaber. Folia opposita, lanceolata, crebre mucronato-serrata, membranacea, pilis crispis tenuiter conspersa, apice gradatim, basi subito acuminata, venis 3 a basi divergentibus, petiolis 1–2 cm. longis. Flores sæpe 2, terminales; calycis tubus subcompressus, urceolatus, 8-costatus, 4 mm. longus, 3 mm. latus; lobi 4, distantes, parvi, lanceolati; petala 4, rosea, orbicularia, breviter unguiculata, 3–4 mm. lata; stamina 8, fertilia petalis æquilonga; corona ovarii apice lacera; stylus indivisus, staminibus brevior. Fructus membranaceus, subcompressus, 5 mm. latus, imperfecte 4-locularis; placentæ a medio columnæ centralis in loculos divergentes, fimbriatæ. Semina minuta, ½–1 mm. longa, angulata.

On the margins of rivulets in the lower woods about Yenping. Hongkong Herb. 2711.

ARALIACEÆ.

Heteropanax fragrans, *Seem.*, var. chinensis, *Dunn*, var. n. Foliola parva, lanceolata, fructu compresso.

Lower woods near Buong Kang, Yenping. Hongkong Herb. 2754. Yunnan, *Henry*, 12,865. Kienning Fu Mountains, *Rickett*, 846. Tonkin,

Balansa, 3457. This seems to be the usual wild form in China. It is usually a small tree with the leaves and panicles collected into a compact bunch at the end of the thin straight trunk, and thus very different from the graceful umbrageous trees of India.

RUBIACEÆ.

Galium asprellum, *Michx.* Hongkong Herb. 2799. A southern extension from its previously known area, which comprised N.E. Asia to Hupeh and Szechuen.

COMPOSITÆ.

Aster auriculatus, *Franch.* Hongkong Herb. 2826. Known previously only from Yunnan.

VACCINIACEÆ.

Vaccinium Carlesii, *Dunn*, sp. n.

Frutex omnino glaber. Ramuli striati, cinnamomei, vetustiores grisei. Folia lanceolata, leviter serrata, 3–4 cm. longa, chartacea, gradatim acuminata, basi obtuse cuneata, venis obscuris, pedicellis 3–4 mm. longis. Racemi in ramulis florigeris paniculas densas ad 10 cm. longas bracteatas formantes, bracteis folia parva simulantibus. Flores parvi, pedicellis 1–2 mm. longis, bracteolis linearibus pedicellos superantibus caducis; calycis tubus hemisphæricus, $1\frac{1}{2}$ mm. longus, 5-lobatus, lobis triangularibus brevibus acutis; corolla alba, campanulata, 3 mm. longa, 5-lobata, lobis ovatis acuminatis, apice reflexo; staminum inclusorum antheræ in tubulos laxos attenuatæ, basi obtuse breviter calcaratæ; filamenta puberula; stylus breviter exsertus.

Foochow at 2000 ft., *Carles*, 630. Yenping, Hongkong Herb. 2871, 2872.

This species might be taken for a small state of *V. Donianum*, Wight, to which it bears a general resemblance.

GENTIANACEÆ.

Gentiana Thunbergii, *Griseb.* Ch'a Ch'un, near Shui Kau on the Min, at 1500 ft. Hongkong Herb. 3359.

An interesting addition to the flora of China as Carles's Kiukiang plant proves to be *G. Zollingeri*, Fawcett (Kusnezow in Act. Hort. Petrop. xv. 375).

GESNERACEÆ.

OREOCHARIS BENTHAMI, *C. B. Clarke*, var. RETICULATA, *Dunn*. Folia subtus reticulata.

Pakwan, Kwantung, *Hance*, 7561 of 1867, not 7561 of 1864, which is the type of the species; White Cloud Hills, Kwantung, *Sampson*, 447 ; Fokien, Hongkong Herb. 3364.

Clarke included under this specific name plants with reticulate and plain leaves and made no varietal distinction between them, because he believed, from the material at his disposal, that the reticulation was merely due to the development of the lamina with age. I have now, however, before me specimens which will not allow of this explanation, *i. e.* young leaves fully reticulate in plants of the above new variety and also typical examples showing no reticulation even in old leaves.

OREOCHARIS AMABILIS, *Dunn*, sp. n.

Herba perennis, scaposa, alabastris petiolis foliorum venis in latere inferiore pedunculis bracteis calycibusque lana brunnea vestitis. Folia radicalia, ovata vel oblonga, irregulariter crenata, 4–12 cm. longa, papyracea, supra pilis crispis adpressis vestita, obtusa, basi rotundata, majorum venis subtus reticulatis, petiolo 4–6 cm. longo. Scapæ 10–18 cm. longæ, lanatæ, glabrescentes, apice 1–2-plo umbellatim ramosæ, umbellis bracteis lanceolatis, 8–12 mm. longis, involucratis. Calyx ad basin 5-lobus, lobis 4–8 mm. longis anguste lanceolatis ; corolla alba (an semper ?), glabra, cylindrica, subobliqua, 20–22 mm. longa, lobis erectis ovatis acutis 6–7 mm. longis ; stamina prope basin corollæ affixa, sinus loborum breviter superantia; stylus compressus, apice in stigma bilobum expansus.

Fokien, Foochow, *Carles*, 587 ; Shao Wu, clothing the faces of damp shady rocks, Hongkong Herb. 3363 ; Yunnan, Mi-lêh, on cliffs, *Henry*, 13,758.

SCROPHULARIACEÆ.

MONOCHASMA SAVATIERI, *Franch.* W. Fokien, Pao Chai Hui at 2000 ft. Hongkong Herb. 3368.

Apparently local in China, being confined to the S.E. temperate region, where it is in some parts a common and characteristic feature of the barer slopes of the mountains. The dehiscence of the capsules is remarkable. The horny endocarp seems invariably to split longitudinally down the middle of the loculus, rolling back elastically, bursting the calyx and thus expelling the seeds.

VERBENACEÆ.

CALLICARPA LONGIPES, *Dunn*, sp. n.

Frutex 1 m. altus, omnino floribus exceptis molliter villosus. Folia subsessilia, obovata vel oblonga, mucronato-dentata, subito acuminata, a medio gradatim ad basin rotundatam vel subcordatam angustata, papyracea. Cymæ parvæ, densæ, axillares, longe pedunculatæ, pedunculis 12–35 mm. longis. Calyx ad medium lobatus, villosus, 2 mm. longus, lobis acutis lanceolatis; corolla rubella, ore gradatim expansa, minime obliqua, extus puberula, calyce duplo longior, lobis brevibus obtusis; stamina exserta, 8–9 mm. longa; stylus filiformis, apice explanatus, staminibus longior. Fructus ignotus.

Natural woods near Yenping at 2500 ft. Hongkong Herb. 3390.

Near *C. rubella* but distinguished by its long peduncles and by the shape of its corolla.

LABIATÆ.

SALVIA BOWLEYANA, *Dunn*, sp. n.

Herba perennis, 1 m. alta. Caulis cum petiolis pedunculis calycibusque plus minus hirsutus. Folia pinnata, 10–12 cm. longa, petiolo 10–12 cm. longo; foliola 7, ovata vel ovato-lanceolata, crenata, papyracea, utrinque sparse pilosula vel subglabra, acuta, lateralia basi oblique, terminalia recte cordata vel rotundata, omnia petiolulata, petiolulis 5–15 mm. longis. Verticilli circiter 8-flori, distantes. Flores bracteolati; bracteolæ lanceolatæ, pedicello 3–4 mm. longo breviores; calyx 10 mm. longus, supra medium leviter constrictus, intus hirsutus, ore expanso bilabiato; labium superius integrum, rotundatum, inferius bidentatum, dentibus parvis mucronatis approximatis; corolla cærulea, bilabiata, labio superiore recto concavo, inferiore æquilongo oblongo, genitalibus longe exsertis.

Banks of the Yuen Fu River near Foochow. Hongkong Herb. 3409.

Related to *S. miltiorhiza*, Bunge, but differing in its 3-jugate leaves and short-hooded corolla.

The specific adjective commemorates the name of Mr. Bowley, Crown Solicitor of Hongkong, and of his sister (now Mrs. L. Gibbs), with whom the early part of our explorations is pleasantly associated.

LAMIUM FOLIATUM, *Dunn*, sp. n.

Herba annua, debilis, procumbens, omnino floribus exceptis molliter hirsuta. Folia ovata, crenata, 4–10 cm. longa, papyracea, obtusa, basi rotundata, inferiorum petiolis laminas æquantibus, superiorum etiam haud multo brevioribus. Verticilli densi, multiflori, axillares, bracteolis linearibus. Calyx membranaceus, hirsutus, 8 mm. longus, lobis æqualibus ovatis mucronatis 1–2 mm. longis; corolla rubella, 15–17 mm. longa, extus

puberula, intus glabra, tubo angusto recto exserto, labio superiore recto oblongo concavo apice immarginato, inferiore æquilongo trilobo, lobis oblongis æqualibus; stamina sub labio superiore approximata, exterioribus longioribus; nuculæ trigonæ, facie exteriore in alam angustam apice producta.

Under shady banks in the lower woods near Buong Kang, Yenping. Hongkong Herb. 3427.

An anomalous plant without the facies of the genus, but separable by no obvious characters.

SCUTELLARIA LUZONICA, *Rolfe*. Hongkong Herb. 3415. This Scull-cap had not previously been found out of the Philippine Islands.

ARISTOLOCHIACEÆ.

ARISTOLOCHIA TUBIFLORA, *Dunn*, sp. n.

Herba scandens, omnino glabra. Folia triangularia, integra, 8–10 cm. longa, papyracea, acuta, apice summo obtuso mucronato, basi sinu rotundato cordata, auriculis rotundatis, venis pedatim a basi radiatis, petiolis 5–8 cm. longis. Flores 1–2-ni, axillares; perianthium fusco-rubrum, 30–35 mm. longum, basi bulbosa, tubo recto angusto ab ore dilatato in labium oblongum æquilongum producto, labio obtuso 5 mm. lato. Fructus ignotus.

Rocky gorge above the city of Yenping. Hongkong Herb. 3472.

Similar in foliage to *A. contorta*, Bunge, but the flowers with an obtuse, not caudate lip.

ARISTOLOCHIA MOLLIS, *Dunn*, sp. n.

Herba breviter scandens. Caulis puberulus, glabrescens. Folia oblongo-triangularia, 8–12 cm. longa, integra, papyracea, supra subscabra, subtus molliter hirsuta, apice summo acuta vel obtusa, basi paullo expansa, sinu rotundato cordata, auriculis rotundatis, venis a basi pedatim radiantibus et 2 vel 3 paribus pinnatis, petiolis 2–3 cm. longis. Flores 1–2-ni, axillares, pedunculis pubescentibus 2 cm. longis, bracteolo amplexicauli 4–12 mm. longo circiter medio instructis; perianthium extus molliter hirsutum, sub-viride, rubro-lineatum; tubus ovalis, 8–10 mm. longus, supra paullo contractus, ore late oblique expanso 15–17 mm. lato, lineis rubris radiantibus notato; ovarium dense pubescens. Fructus ignotus.

On walls at Siu Yuk, Min River. Hongkong Herb. 3470.

Recalling *A. heterophylla* in all but its flowers, which are widely different in shape.

PIPERACEÆ.

PIPER DINDIGULENSE, *Miq*. Hongkong Herb. 3478. New to the flora of China.

PIPER FUTOKADSURA, *Sieb. & Zucc.* Hongkong Herb. 3481. The species was previously known from Japan, Liu Chiu Islands, and Formosa.

CHLORANTHACEÆ.

CHLORANTHUS OLDHAMI, *Solms.* Hongkong Herb. 3482. Formerly known only from Formosa.

LAURACEÆ.

MACHILUS SHEARERI, *Hemsl.* Hongkong Herb. 3490. A southern extension of the known area from Chekiang and Kiangsi.

MACHILUS GRIJSII, *Hance.* Drupa nigra globosa, 8–10 mm. diam., calyce persistente 6 mm. longo, pedunculo crasso carnoso corallino.

Woods along the Tap Ling Ho, near Shui Kau, 80 miles from Foochow.

The fruit had not been described. The clustered scarlet peduncles of the fruit make the tree in May a beautiful and striking object.

EUPHORBIACEÆ.

PHYLLANTHUS PULCHER, *Wall.* Hongkong Herb. 3513. Previously known only as an Indian species.

MALLOTUS ROXBURGHIANUS, *Muell. Arg.*, var. GLABRA, *Dunn*, var. n. Frutex omnino glaber.

Buong Kang village near Yenping. Hongkong Herb. 3427.

MALLOTUS RETICULATUS, *Dunn*, sp. n.

Frutex 5 m. altus, præter paginam foliorum superiorem omnino breviter hirsutus et plus minus glandulis rubris sessilibus conspersus. Folia oblongo-ovata, serrata, 12–22 cm. longa, chartacea, supra glabra, costa impressa, infra dense reticulata, gradatim acuminata, basi rotundata vel obtusa, venis 7–8 paribus, infimis basalibus, petiolis 3–4 cm. longis. Racemi (fœminei tantum visi) terminales, fasciculati, sessiles, multiflori. Flores fœminei 4 mm. longi, pedicello longiores, bracteis linearibus, minutis; calyx 5-partitus, lobis linearibus 2 mm. longis; ovarium globosum, 3-loculare, stylo brevi, stigmatibus tribus plumosis. Fructus ignotus.

Hill-side at Wong Ka Chi, West Fokien. Hongkong Herb. 3429. Resembles *M. philippinensis*, Muell. Arg., but the leaves are serrate and finely reticulate beneath.

URTICACEÆ.

FICUS HETEROMORPHA, *Hemsl.* Previously recorded no further south than Kiangsi. Hongkong Herb. 3453.

NANOCNIDE LOBATA, *Wedd.* Only recorded previously from the Liu Chiu Islands and from Chekiang.

PILEA AQUARUM, *Dunn*, sp. n.

Herba annua, tenera, 30–40 cm. alta. Caulis simplex, præter apicem glaber, inferne procumbens, radicans. Folia opposita, elliptica, crenata, 4–6 cm. longa, membranacea, supra punctis minutis linearibus crebre notata, subtus in venis decidue puberula, apice basique angustata, obtusa, venis 3 a basi radiantibus, petiolis 2–4 cm. longis, stipulis membranaceis semicordatis, breviter petiolo adnatis. Cymæ axillares, condensatæ, 5 mm. longæ, tandem circinnatæ. Calyx fructescens, hispidus, 1 mm. latus, achenium globulare lucidum flavum includens.

On the "3800 Steps Pass" near Yenping, on rocks under the constant drip of water. Hongkong Herb. 3477.

Distinguished from *P. pumila*, A. Gray, its nearest ally, by its crenate leaves and large stipules.

CUPULIFERÆ.

QUERCUS HARLANDI, *Hance*, var. INTEGRIFOLIA, *Dunn*, var. n. Folia subplana, integra.

Woods near Yenping, and among the gorges of the Yuen Fu River. Hongkong Herb. 3492. The type is, so far as is known, confined to Hongkong Island.

QUERCUS THALASSICA, *Hance*, var. OBTUSIGLANS, *Dunn*, var. n. Glandes apice rotundatæ.

Fong Kong Tze near Foochow. Hongkong Herb. 3486. The same variety occurs in the Island of Hongkong on Mt. Davis under Hongkong Herb. No. 2081.

QUERCUS EDITHÆ, *Skan.* A welcome extension of the known area of this fine oak. Previously only from Kwantung.

QUERCUS SKANIANA, *Dunn*, sp. n.

Arbor sempervirens, 10 m. alta. Ramuli pube fusca molli vestiti. Folia oblongo-obovata, integra, 10–15 cm. longa, coriacea, supra glabra, costa prominula, venis secundariis impressis, subtus præcipue in venis molliter pubescentia, costa venisque prominentibus, subito acuminata, basi cuneata,

petiolis 6–10 mm. longis. Spicæ axillares, erectæ, monœciæ, circiter 15 cm. longæ, pedunculo pubescente. Flores masculi approximati, fœminei, 3–5-ni distanter glomerati, squamis pubescentibus. Glans depresso-globosa, breviter acuminata, cupula fere inclusa et ejus basi adhærens, 15–20 mm. lata ; cupula squamis imbricatis parvis acuminatis adpressis vestita, sæpe cum floribus paucis haud evolutis basi conglomerata.

In natural woods at 2500 feet in the Yenping Mountains. Hongkong Herb. 3487.

Allied to *Q. Blumeana*, Korth., but this has solitary acorns and glabrous leaves.

This species is dedicated to my friend Mr. Skan of the Kew Herbarium staff, to whom we are indebted for much of our knowledge of the Oaks of China.

CASTANOPSIS HYSTRIX, *A. DC.* Hongkong Herb. 3498. A notable extension of its known Chinese range, which only reached Yunnan.

CONIFERÆ.

CUPRESSUS (§ CHAMÆCYPARIS) HODGINSII, *Dunn*, sp. n.

Arbor 10–15 m. alta, omnino glabra. Rami paullo dependentes, in flabella foliosa lata gracilia complanati. Folia polymorpha, quaterna, inter se connata, ramulis adnata et eos omnino includentia, ramulorum vetustiorum linearia, 7–8 mm. longa, apicibus breviter liberis cuspidatis, juniorum facialia et dorsalia cuneata, tricarinata, 8 mm. longa, cuspidata, lateralia alam lanceolatam acuminatam fere medio liberam formantia, sæpe infra linea glauca notata. Conus squamis 12 decussatis peltatis apice excavatis formatus. Semina 8–10 plano-convexa vel obtuse trigona, ovalia, 4 mm. longa, acuta, basi obtusa, bialata, ala majore ovata 5 mm. longa, minore angusta apice paullo producta.

Woods about Yenping at 2000 feet (small trees not in flower or fruit). Hongkong Herb. 3505. Large trees in fruit near Foochow, *Hodgins*.

I am glad to have the opportunity of naming this fine tree after my friend Capt. Hodgins of the S.S. 'Haiching' of Hongkong, who has succeeded in procuring its cones from Foochow. Capt. Hodgins has been remarkably successful in obtaining specimens of scientific and economic interest from the neighbourhood of that port, and many of his collections are exhibited in the Hongkong Court of the Imperial Institute.

ORCHIDACEÆ.

MICROSTYLIS MINUTIFLORA, *Rolfe*, sp. n.

Herba pusilla, caule basi in pseudobulbum parvum incrassato unifoliato.

Pseudobulbi subglobosi, 3–8 mm. lati. Folia petiolata, ovata vel suborbicularia, apiculata, 1–1·5 cm. lata; petiolus 5–8 mm. longus. Scapi graciles, suberecti, puberuli, 3–9 cm. longi; racemi multiflori; bracteæ lineares, acutæ, 0·5 mm. longæ; pedicelli graciles, 1 mm. longi. Flores 1·5 mm. lati; sepala patentia, oblonga, obtusa; petala linearia, acuta, sepalis paullo breviora; labellum trifidum; lobi laterales lineares, acuti, divergentes, petalis paullo breviores; lobus intermedius triangulari-oblongus, subacutus, lobis lateralibus paullo major; columna brevis, alis minutis.

Damp rocks in shade, Yuen Fu Gorges, at 1800 ft. Hongkong Herb. 3545.

A very distinct species, and remarkable for its very minute flowers, whose structure is only made out with difficulty from dried specimens.

Liparis Dunnii, *Rolfe*, sp. n.

Herba circa 15 cm. alta, basi incrassata, diphylla. Folia breviter petiolata, ovato-oblonga, obtusa, membranacea, circa 13 cm. longa, 6 cm. lata. Scapus crassiusculus, 15–18 cm. altus; racemus multiflorus; bracteæ ovatæ, acutæ, 2 mm. longæ; pedicelli circa 1 cm. longi. Sepala divergentia, lineari-oblonga, acuta, subæqualia, circa 1 cm. longa; petala filiformi-linearia, acuta, 1 cm. longa; labellum orbiculari-obovatum, apiculatum, minutissime undulatum, 1 cm. longum, basi minute tuberculatum; columna clavata, incurva, 4 mm. longa.

Rocks at Tze Chuk Hang, W. Fokien, at 3000 ft. "Flowers metallic black." Hongkong Herb. 3544.

This species somewhat resembles *L. pauciflora*, Rolfe, in habit and foliage, but has a much stouter, densely-flowered scape, and flowers about twice as large. The colour as recorded is unusual, and is not retained in the dried flowers. [I did not see these plants in a fresh state and cannot confirm the peculiar colour, but it was stoutly averred by the Chinese collector to be as stated.—S. T. D.]

Phaius maculatus, *Lindl.* Hongkong Herb. 3541. An addition to the known flora of China; it was previously recorded from India only.

Dendrobium aduncum, *Wall.* Hongkong Herb. 3525. Previously recorded only from Kwantung and India.

Tainia Dunnii, *Rolfe*, sp. n.

Caules epseudobulbosi, breves, vaginis membranaceis obtecti. Folia solitaria, petiolata, lanceolata, acuminata, 13–18 cm. longa, 2–2·5 cm. lata, membranacea; petioli 2–3 cm. longi. Scapi erecti, graciles, 30–40 cm. alti; racemi laxi, multiflori; bracteæ lanceolatæ, acuminatæ, 4–6 mm. longæ; pedicelli graciles, 1–1·3 cm. longi. Sepalum posticum lanceolatum, acutum, circa 1·3 cm. longum; sepala lateralia falcato-lanceolata, acuta, 1·3 cm.

longa; petala falcato-lanceolata, acuta, 1·3 cm. longa; labellum trilobum, suborbiculare, 1 cm. longum; lobi laterales late falcato-oblongi, subacuti; lobus intermedius transverse oblongus, apice plicatus; discus bicarinatus; columna clavata, arcuata, 6–7 mm. longa; mentum obtusum, 3 mm. longum.

Rocky banks near Buong Kang. Flowers brownish yellow [S. T. D.]. Hongkong Herb. 3542.

Comparable with the Malayan *Tainia latilingua*, Hook. f., which has a very similar lip, though the latter is readily distinguished by its broad, very long-petioled leaves and larger bracts.

PHOLIDOTA CHINENSIS, *Lindl.* Hongkong Herb. 3546.

A northern extension of the known area of the species, which was previously on record from Hongkong and the island of Hainan.

CYNOSORCHIS CHINENSIS, *Rolfe*, sp. n.

Herba nana, tubere ovoideo-globoso, caule brevi sæpissime monophyllo. Folia subsessilia, oblonga vel elliptico-oblonga, subacuta, 3–5 cm. longa, 1–1·5 cm. lata, membranacea. Scapi graciles, erecti, glabri, 6–10 cm. longi, supra medium vagina lanceolata obtecta; racemi laxi, 5–12-flori; bracteæ ovatæ vel ovato-lanceolatæ, acuminatæ, 2–5 mm. longæ; pedicelli 5–7 mm. longi. Sepala subconniventia, ovata, subacuta, 3 mm. longa; petala sepalis similia, paullo ampliora; labellum trilobum, 5 mm. longum; lobi laterales obovato-oblongi; lobus intermedius obovatus, apice tridenticulatus; calcar gracile, 2 mm. longum; columna brevissima.

"3800 Steps Pass" at 2500 ft. Flower purple [S. T. D.]. Hongkong Herb. 3543.

Near *Cynosorchis gracilis*, Kränzl. (*Gymnadenia gracilis*, Miq.), but the leaves proportionately shorter and broader, and the flowers rather larger and with broader segments.

PALMÆ.

CALAMUS HOPLITES, *Dunn*, sp. n.

Frutex erectus, 2–3 m. altus, fortissime armatus. Folia oblonga, 2–3 m. longa, petiolis glabrescentibus, spinis validis paullo compressis 2–3 cm. longis armatis; segmenta linearia, chartacea, costis marginibusque spiculis vestita, infra ternatim opposita (an semper?), apice flabellatim aggregata. Panicula juvenis et vetusta tantum visa; juvenis 40 cm. alta; rami bracteis cinnamomeo-pulverulentis apice laceris 18 cm. longis vaginati. Alabastra 4 mm. longa, 2 mm. lata, extus striata. Rami paniculæ evolutæ 30 cm. longi, decurvati, pinnatim in spicas multas divergentes divisi.

Lower woods at Buong Kang near Yenping. Hongkong Herb. 3590.

Very near *C. thysanolepis*, Hance, but distinguished by the armature of the leaves as well as by its smaller flowers.

HÆMODORACEÆ.

Aletris scopulorum, *Dunn*, sp. n.

Herba perennis, 15–30 cm. alta, scaposa, rhizomate brevi, radices fibrosas copiosas emittente. Folia radicalia, linearia, 6–12 cm. longa, 2–4 cm. lata, glabra, acuta. Scapa superne puberula, bracteis 2–4 linearibus 4–12 mm. longis in parte inferiore instructa. Racemus 5–8 cm. longus, sæpe 10–15-florus. Flores 4–5 mm. longi; pedicelli 3 mm. longi; bracteæ lineares pedicellos excedentes, omnes puberuli; calycis tubus hemisphæricus; lobi 6, tubum æquantes, lineares, acuti; stamina 6, sepalis opposita et eis paullo breviora; ovarium inferum, 3-loculare. Fructus loculicide apice dehiscens.

Damp rocks at Sui Kai Kau, near Foochow. Hongkong Herb. 3556.

Closely related to *A. glanduligera*, Franch., and differing only in its acute linear calyx-teeth and its short lower bracts.

IRIDACEÆ.

Iris speculatrix, *Hance*. Hongkong Herb. 3561. An extension of the known range of this interesting "adventuress," which was only recorded before from Kwantung.

DIOSCOREACEÆ.

Dioscorea rhizopogonoides, *Oliver*. Hongkong Herb. 3563. On previous record only from the islands of Formosa and Hongkong.

D. zingiberensis, *C. H. Wright*. Hongkong Herb. 3564–5. Known previously only from the province of Hupeh.

LILIACEÆ.

Smilax lævis, var. ophirensis, *A. DC*. Hongkong Herb. 3570. Hitherto only gathered in Sumatra.

ARACEÆ.

Pinellia Browniana, *Dunn*, sp. n.

Herba perennis, glabra, tuberosa, scaposa. Tuber ovale, 2–4 cm. longum, radices fibrosas copiosas emittens. Folia triangularia vel oblongo-ovata, 15–25 cm. longa, membranacea, acuminata, basi cordata, sinu acuto, auriculis paullo divergentibus rotundatis vel acutis, petiolis 15–25 cm. longis. Pedunculus 15–18 cm. longus; spatha viridis, 5–6 cm. longa, oblonga, obtusa, apice erecto vel nutante. Antherarum spica 8 mm. longa, spadice mire attenuato ad 20 cm. longo filiformi; ovarium 12 mm. longum, in uno latere ovulis plenum.

Damp woods at Fong Kong Tze near Foochow, Hongkong Herb. 3711. Wet rocks at Tam Chuk Hang near Foochow, Hongkong Herb. 3718. Although the leaves of the Fong Kong Tze plants have rounded lobes, while those of the specimens from Tam Chuk Hang are acute, giving the two forms a somewhat different facies, the divergence does not appear sufficient for the foundation of two species or even of two varieties. *P. cordata*, Brown, is allied. The trivial name commemorates the service to Chinese botany of Mr. N. E. Brown, the auther of the account of the Aroids in Hemsley and Forbes's "Enumeration" (Journ. Linn. Soc., Bot. xxxvi. (1903) 173–188).

PINELLIA CORDATA, *N. E. Br.* Hongkong Herb. 3716–7. The known area of the plant is hereby extended southwards from Chekiang to Kiangsi.

ACORUS CALAMUS, *Linn.* Hongkong Herb. 3713. Previously known no further south than Kiangsi.

CYPERACEÆ.

SCIRPUS FILIPES, *C. B. Clarke.* Hongkong Herb. 3606. Described from specimens collected in Fokien by De Grijs. It was found in great abundance in the gorge at Buong Kang, where it formed a dense growth on the steep, almost precipitous banks of the stream.

CAREX RADICIFLORA, *Dunn*, sp. n.

Cæspitosa, scaposa. Folia gradatim acuta, 40–50 cm. longa, 2 cm. lata, margine scabra, basi fibris brunneis cincta. Culmi desunt. Spicarum 1 mascula et 2–3 fœmineæ, pedunculatæ cum multis bracteis imbricatis membranaceis ex rhizomate in fasciculo ortæ, et ergo fere inter foliorum bases occlusæ; mascula 3 cm. longa, bracteis paullo longior, pedunculo 3–4 cm. longo; fœmineæ paullo breviores; glumæ utriculis 3-plo breviores, rotundatæ, medio trinerviæ, mucronatæ. Stylus trifidus; utriculus 6–7 mm. longus, glaber, brunneus, opacus, striatus, in rostrum subito contractus; nux trigona, rostro cylindrico.

Among rocks at Siu Kai Kau, 1700 feet, near the Min River, about 80 miles above Foochow. Hongkong Herb. 3653.

The inflorescence of this remarkable sedge, which in other respects approaches *C. Harlandi*, resembles the tuft that would be left if the flowering stem of one of the scapose sedges were drawn between the fingers so as to remove the bracts and spikes.

CAREX FOKIENENSIS, *Dunn*, sp. n.

Glabra. Radix cæspitosa, fibras copiosas circum culmos gerens. Folia 20–30 cm. longa, ad 5 mm. lata, marginibus venisque scabra. Culmi 25 cm.

longi foliosi. Bracteæ longe vaginatæ, inflorescentiam superantes, inferiores foliaceæ, superiores filiformes. Spicarum 1 mascula, 25 mm. longa, 2–3 mm. lata, 5–9 fœmineæ (paucæ basi breviter masculæ), 3–4 cm. longæ, 10–12 mm. latæ, pallide virides, pedunculis exsertis; glumæ fœmineæ ovatæ, acutæ, hyalinæ, costa viridi, utriculo breviores. Stylus trifidus; utriculus patens, globosus, inflatus, 4–5 mm. longus, glaber, levis, in rostrum attenuatum.

Yenping Mountains at 3000 feet. Hongkong Herb. 3658 A.

CAREX RIVULORUM, *Dunn*, sp. n.

Rhizoma repens, foliorum veterum basibus brunneis vestitum. Folia radicalia 80–90 cm. longa, 3 mm. lata, margine scabra, parte superiore in tubum externe scabrum, revoluta. Culmus scaber, 70–100 cm. longus, basi foliis paucis, brevibus vaginatus, medio nudus, apice bracteis 3 laxe vaginatus, vaginibus levibus. Spicarum 1 mascula, terminalis, 8 cm. longa, 4 mm. lata, 2 parte inferiore fœmineæ, apice masculæ, 5–8 cm. longæ; glumæ fœmineæ lanceolatæ, acuminatæ, amplexicaules, 9–11 mm. longæ. Stylus trifidus; utriculus ascendens, ovalis, longe acuminatus, brunneus, striatus, 7–8 mm. longus.

Among rocks by mountain rivulets at Sui Kai Kau, near the Min. Hongkong Herb. 3651.

CAREX GRACILIFLORA, *Dunn*, sp. n.

Rhizoma repens, scapigerum. Folia 50–60 cm. longa, 7–8 mm. lata, glabra, supra scaberula, infra levia. Culmus 25–28 cm. longus, bracteis laxis membranaceis basi nodisque circiter 5 vaginatus, nodo inferiore a basi 6 cm., aliis inter se superne gradatim minus distantes. Pedunculi 1–3-ni, bracteis semi- vel minus inclusi; spicæ glabræ, omnes basi breviter fœmineæ, apice masculæ 13–15 mm. longæ; glumæ fœmineæ utriculo breviores, ovatæ, obtusæ, subeveniæ. Stylus 2-fidus; utriculus patens, ovalis, apice angustatus, decurvatus, haud rostratus, 2–3 mm. longus, fuscus, striatus, glaber.

By rivulets near the Min at Sui Kai Kau, 1200 ft. Hongkong Herb. 3657. Allied to *C. brunnea*, Thunb. Well marked when in fruit by its neat linear male spikes, each surmounting a few spreading utricles.

CAREX GRANIFERA, *Dunn*, sp. n.

Rhizoma cæspitosum, fibras fuscas copiosas, circum folia gerens, scaposum. Folia glabra, 60–80 cm. longa, 6 mm. lata, supra scabra, subtus levia. Scapæ 4–5 cm. longæ, bracteis paucis scariosis imbricatis, basi vaginatæ, spicam 1 masculam et 2 fœmineas in apice approximatas gerentes; spicæ bracteis breviter vaginantibus pedunculos includentibus paullo superatæ, paucifloræ, ovatæ, 10–15 mm. longæ; glumæ fœmineæ lanceolatæ, acuminatæ, costa viridi, utriculis subæquales. Utriculus ovalis, trigonus, in rostrum æquilongum angustatus, stramineus, glaber, præter rostrum scaberulum levis.

Woods at Tap Ling Ho near the Min River, some 80 miles above Foochow. Hongkong Herb. 3655.

The utricles have the peculiar shining yellow appearance of grains of barley.

CAREX CUSPIDOSA, *Dunn*, sp. n.

Cæspitosa, glabra et præter apices foliorum culmorum glumorumque asperas levis, 40 cm. alta. Folia 15 cm. longa, 2 mm. lata. Culmi 20–30 cm. longi, foliosi, foliis paucis et bracteis inferioribus superati, apice 4–6 spicas approximatas, unam apice basique vel omnino masculam, alias apice masculas gerentes; bracteæ amplexicaules vel brevissime vaginantes; spicæ 1 cm. longæ, masculæ anguste ovatæ, fœmineæ ovatæ. Stylus trifidus; glumæ fœmineæ, præter infimas rotundatæ, retusæ, costa viridi in cuspidem patentem, lamina longiorem et utriculum longe superantem excurrente; utriculus ovalis, apice angustatus, haud rostratus.

Banks of the Yuen Fu near Foochow. Hongkong Herb. 3643.

The spikes have a peculiar appearance in consequence of the long spreading points of the glumes.

CAREX TRANSVERSA, *Bl.* Hongkong Herb. 3654. Kiangsu and Chekiang were the previously known area of this sedge.

C. ISCHNOSTACHYA, *Steud.* Hongkong Herb. 3647. An addition to the Chinese flora, and in the province where it might have been expected to occur considering its range in Japan and the Liu Chiu Islands.

C. SPACHIANA, *Boot.* Hongkong Herb. 3618 and 3641. Previously supposed to be endemic to Kwantung.

GRAMINEÆ.

PHYLLOSTACHYS NIGRA, *Munro.* Hongkong Herb. 4577. This Japanese bamboo has already been recorded from Szechuen, and is now found to be one of the most used of all the bamboos in Fokien.

A Revision of the Genus *Codonopsis*, Wall. By T. F. Chipp.

(Communicated by W. Botting Hemsley, F.R.S., F.L.S.)

(With 4 Text-figures.)

[Read 19th March, 1908.]

Owing to the material recently collected by Mr. A. Henry and Mr. E. H. Wilson, it has become desirable to attempt a short account and enumeration of the species of the genus *Codonopsis* of the Natural Order Campanulaceæ. Under the generic name of *Codonopsis* I have included *Codonopsis* of Wallich, as enunciated in Roxburgh's 'Flora Indica,' ed. Carey, vol. ii. p. 105, *Glosocomia* of D. Don, in his 'Flora Nepalensis,' p. 158, and many species which though obviously allied to both these genera could not be included under either of them.

An alternative would have been to have kept the original *Codonopsis* and *Glosocomia* distinct genera, but this would have entailed the making of several new genera for those species not coming under either, which have been brought to light by the above-mentioned collectors.

A comparison of the original descriptions of *Codonopsis* and *Glosocomia* shows these differences :—*Codonopsis* has sublinear filaments, a three-lobed stigma, and a three-celled ovary ; *Glosocomia* has glabrous filaments dilated at the base, setose anthers, two-lobed stigmas, and a five-celled ovary. The characters of the stigma and ovary have no diagnostic value, as they have been found to vary from 3- to 5-merous in the same species ; but with regard to the filaments, which is the only other stated difference, not only do the two distinct forms as given above occur, but also every intermediate stage between them. On these considerations, therefore, it has been thought best to group all the species together, retaining for them Wallich's original name of *Codonopsis*.

As to the position of the genus in its extended form:—Following the divisions of Campanulaceæ as given in Bentham & Hooker's 'Genera Plantarum,' vol. ii. p. 557, it belongs to the tribe Campanuleæ with the regular corolla and free stamens, and under the subdivision of those with dehiscent capsules, as opposed to those with indehiscent berries. The genera nearest allied to it are *Platycodon* of De Candolle, the only species of which is an erect, robust plant, with sessile leaves and very large flowers, while *Codonopsis* is a scandent or climbing herb, or at most only suberect with weak stems and nearly always petioled leaves ; *Leptocodon* of J. D. Hooker & Thomson, which differs in having five epigynous glands ; and *Campanumœa* of Blume, which has baccate fruit.

When Wallich described the genus in 1824 only three species were known, and one of them was so unlike the other two that he says he was of the opinion it ought to have been put in Polemoniaceæ. He mistook the short sterile foliaceous branches for compound leaves, resembling those of *Polemonium*.

The amount of variation in so small a genus, as is shown in the habit, leaves, and hairiness, which is here generally due to variation in habitat, is remarkable, but by far the most striking feature is the various combinations between the two outer floral whorls, and on this I have based the principal divisions of the genus. There are distinctly four—firstly, that with the calyx inferior and the corolla superior (fig. 1); secondly, where the calyx is semi-superior, the corolla still superior (fig. 2); thirdly, where the calyx and corolla are semisuperior (fig. 3); and fourthly, with the calyx superior (fig. 4).

Fig. 1.

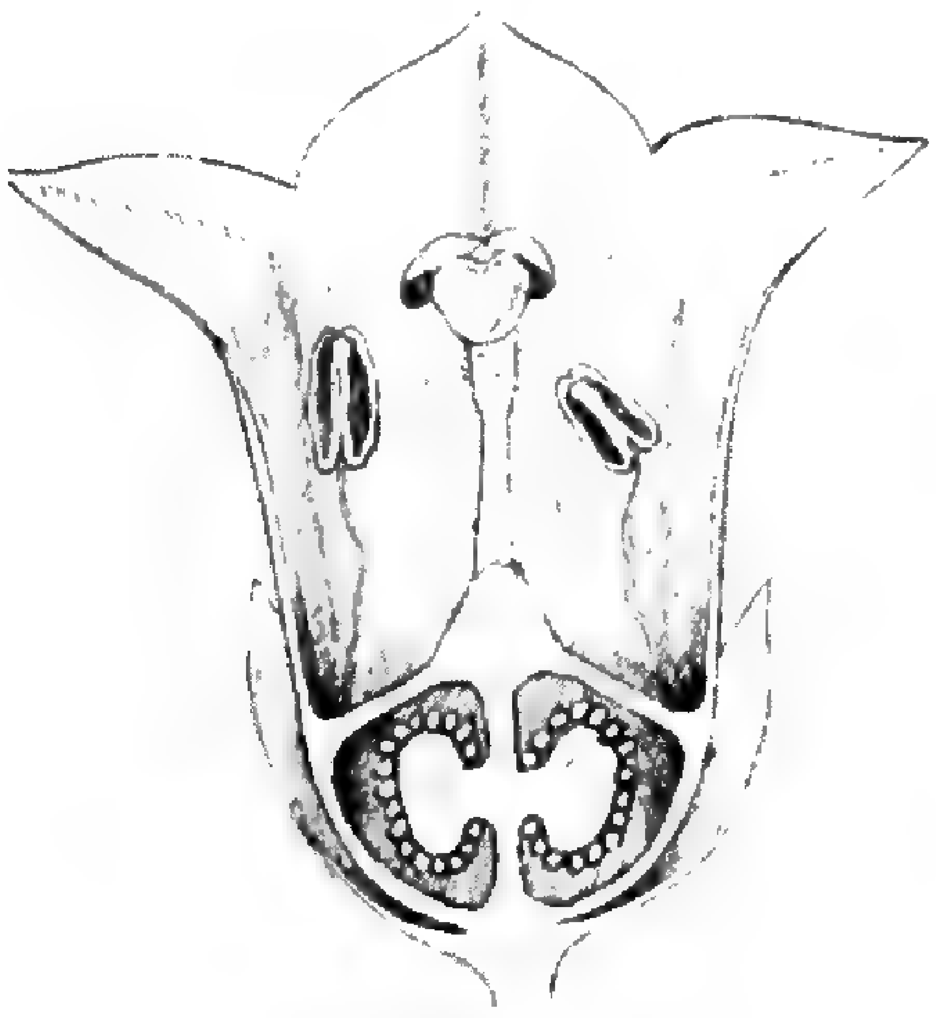


Fig. 2.

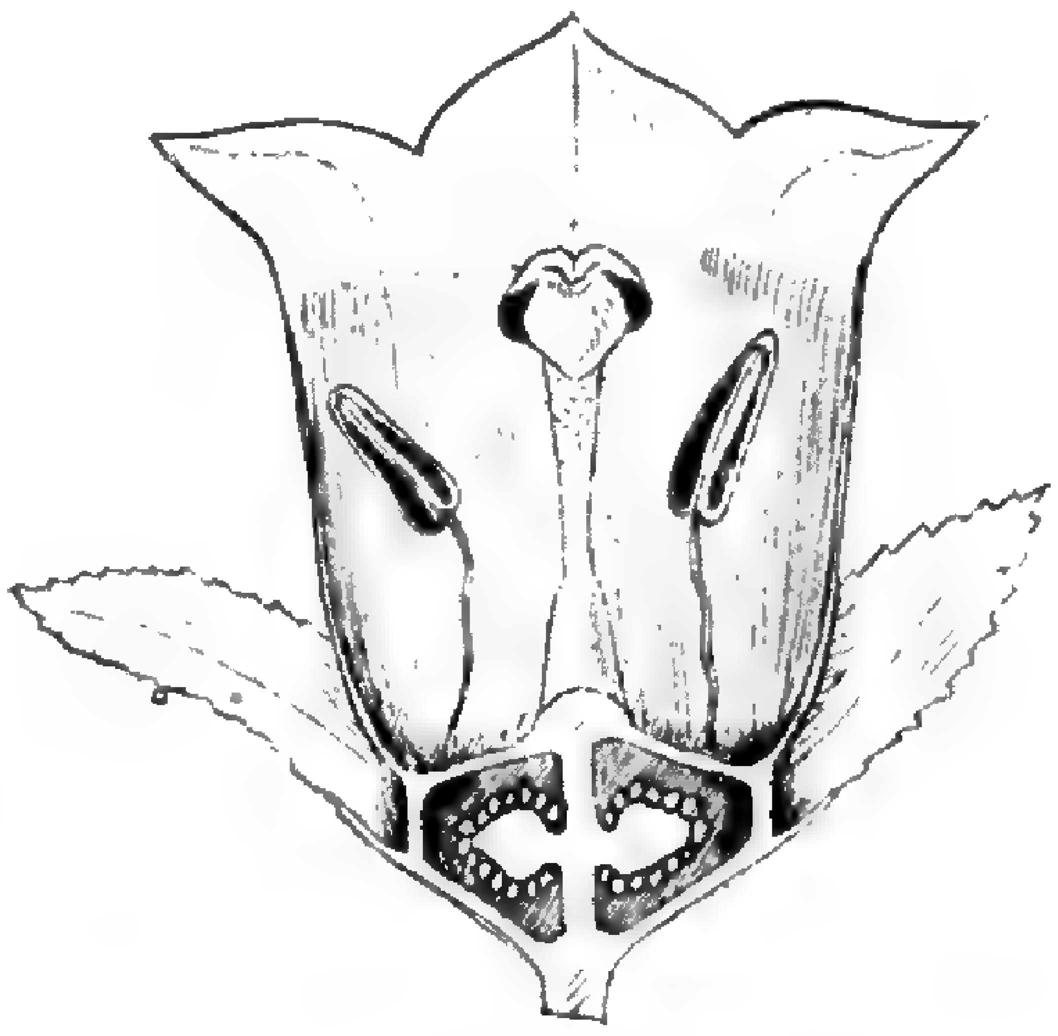


Fig. 3.

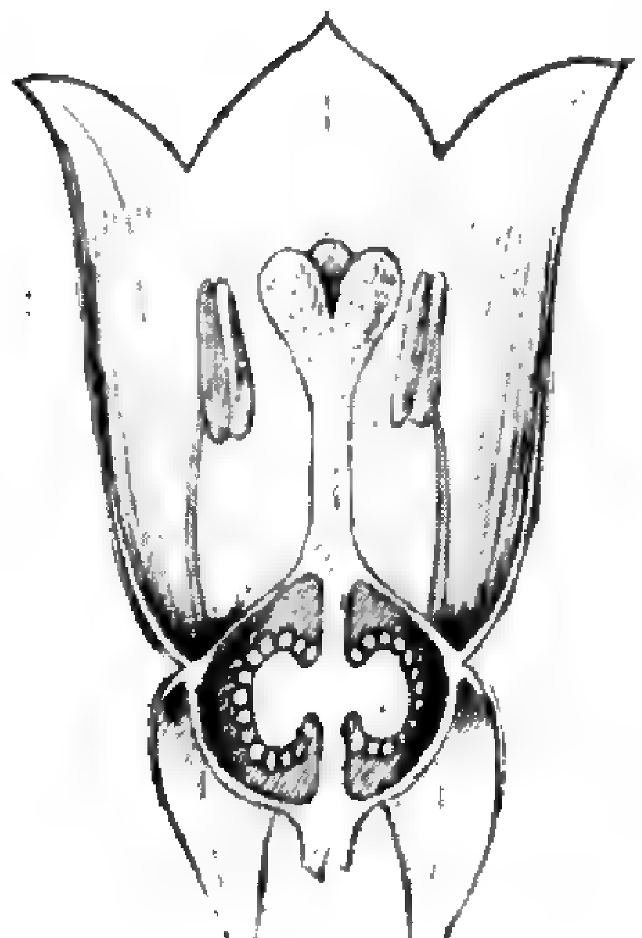
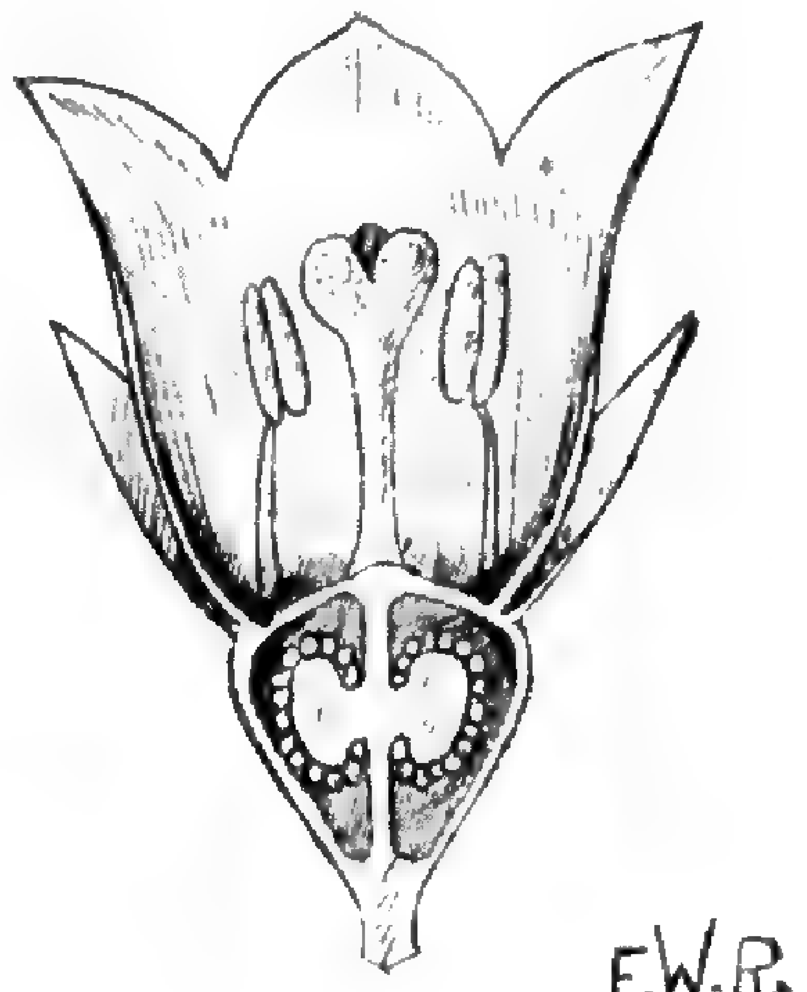


Fig. 4.



So far as I can ascertain, this case has not been clearly stated before, but only passing allusions have been made to it. De Candolle, in his Monograph of the Campanulaceæ in 1830, regards the calyx as an involucre, and I was inclined to that opinion myself at first. Those who have called it an involucre have regarded the calyx to consist of a slight rim or ridge running round the corolla at the point where the latter leaves the ovary.

The following facts support the view that these members form the true calycine whorl. On sections being taken through the corolla the rim or ridge can be seen to be in direct continuation with the rest of the corolla, and

there does not appear to be any trace of an abortive whorl. Moreover, the ridge is not visible in living flowers until the corolla is somewhat faded or pressed, and is merely an infolding of the lower part of the corolla-tube above a thickened basal portion. Again, the varying positions of the calyx are to be somewhat expected, as in some specimens examined the calyx-lobes were seen to be inserted in a distinct spiral and not in a whorl, showing that the insertion of each calyx-lobe is liable to vary. Another point in support of this is its position with regard to the other floral whorls. Its lobes invariably alternate with the corolla-lobes and are opposite to the stamens, while with an involucre one would rather expect its members to alternate with the calyx-lobes and so be opposite the corolla. The venation also is quite normal and does not point to any suppression of parts. There is therefore the calyx inferior, semisuperior, and superior. Similar cases are to be found in *Campanumœa*, in several of the Goodeniaceæ, and in *Lagenocarpus* of Ericaceæ (see Fl. Cap. vol. iv. p. 417).

The corolla beyond the varying adnation of the base of the tube is more or less constant. In one species, however, it is so deeply cleft as to give it the appearance of a polypetalous corolla. In one or two species also it possesses a projecting rim, generally marking a delimitation in colour, about halfway down on the inner side.

The colour of the corolla would suggest the mode of pollination in some species. For this purpose the genus might be separated into those with bright blue or other highly attractive colours, and those with a dull red or lilac inside and a glaucous green outside. Of the latter I have observed one or two interesting points, especially in connection with *C. lanceolata*. In all the species the outside of the stigma-lobes is densely scabrid, and in the species under observation it was noticed that when the pollen is ripe—that is, before the stigma-lobes are open—the anthers are closely applied to this part of the stigma, after which they resume their normal positions against the corolla, but leaving their pollen on the outside of the stigma. Further homologous cases are mentioned and discussed under the heading of "Autogamy" in Kerner & Oliver's Nat. Hist. Plants, vol. ii. p. 361. The disc of the flower at first is glistening with honey, and one invariably finds two or three ants inside. These points, coupled with the fact that these flowers generally have a rank smell, would suggest that they are pollinated by ants, flies, and such insects. Similar circumstances in other campanulate flowers are mentioned by Kerner & Oliver, *l. c.* p. 163. The disc of the flower is frequently marked with a pentagon of a different colour, so that the minute colouring of the inside of the flowers is often very effective.

The roots of one of the species, *Codonopsis Tangshen* in particular, and others in a less degree, are extensively used in China for medicinal purposes owing to their "tonic and aphrodisiac properties." Full accounts of this have already appeared in Hooker's 'Icones Plantarum,' t. 1966, and in the

Kew Bulletin, 1907, p. 9; and I cannot do better than refer to them. Some species, too, have been noticed to contain a milky juice, but as only a few species are known in the living state it is uncertain whether it exists throughout the genus.

The majority of species of *Codonopsis* in cultivation appear quite hardy and do not require any special attention, although otherwise they scarcely recommend themselves to the gardener owing to their unattractive appearance. One species *C. convolvulacea*, which is distinctly the prettiest in cultivation, requires some protection and is perhaps more suitable for pot-culture, see Bot. Mag. tab. 8178. The remaining species in cultivation are: *C. lanceolata*, *C. ovata*, *C. rotundifolia*, *C. ussuriensis*, *C. Tangshen*, and *C. viridiflora*.

As to the distribution of this genus:—Owing to the small amount of material at present to hand we can form only a general idea; but this, however, is very interesting and shows that the genus is found almost exclusively at considerable elevations, sometimes reaching an altitude of 13,000 feet. The general area marked out at present is a semicircular band, having its most north-easterly station yet recorded in the north of the Sikhora Alin Mts., on the watershed of the river Amur, about 141° E. and 51° N., thence running along these mountains as far south as Vladivostock. One specimen has been recorded from the mountains near Pekin. It next appears on the mountains of the northern island of Japan, and passes along the mountains in the centre of the south island. There is then a slight break in the line, as its next station is in the mountains of western Hupeh, and thence seems to be generally spread over the Yung-ling Mts. as far as the province of Kansu to the north and down through Yunnan in the south. It can then be traced through tthe mountains of the Shan States in Northern Burma, where it reaches its southernmost point at a latitude of 21° N., to the Khasia Hills of Assam. It is next recorded from the Phari and Chumbi district, and also further north from the Tsangypo watershed and Lhassa. It has been collected all along the southern slopes of the Himalayas through Kashmir to the watershed of the Kurram River in Afghanistan, and its most western representative yet recorded is from the Alexandrovski and Alatau Ranges in Russian Turkestan at about 79° E. and 43° N.

One cannot help thinking from the striking variation in the small amount of material at present available, and the large, though not as yet always connected, area of distribution, that this will probably prove a large and remarkable genus.

My thanks are due to Mr. L. A. Boodle for having examined the morphology of the floral whorls, and to Mr. F. W. Rolfe for the accompanying figures.

CODONOPSIS†, *Wall. in Roxb. Fl. Ind. ed. Carey*, vol. ii. p. 103.

Herbæ perennes. *Radices* tuberosæ vel elongatæ, lignosæ. *Caules* ramosi, gracillimi vel robusti, scandentes, volubiles vel erecti, glabri vel pilosi. *Folia* opposita, alterna vel fasciculata, subsessilia vel petiolata, simplicia, glabra vel hirsuta. *Flores* 1–3 terminales, oppositifolii, axillares vel extra-axillares; pedunculi glabri vel pilosi. *Calyx* inferus, semisuperus vel superus; tubus glaber vel pilosus, striatus; lobi sinu acuto vel obtuso sejuncti, glabri vel pilosi. *Corolla* campanulata, infundibuliformis vel tubulosa, viridis, albida, purpurea vel cærulea; tubus glaber vel sparsim pilosus; lobi ovati vel triangulares, acuti vel obtusi. *Filamenta* subulata, glabra, vel ad basin dilatata et intus appendice ciliata instructa, subulata, vel e basi subulata glabra vel densissime pilosa; antheræ subbasifixæ, erectæ, oblongæ, introrsæ, biloculares, extus carinatæ vel planæ, obtusæ; carinæ setis cristatæ. *Stylus* basi dilatatus, erectus, teres, glaber vel pilosus; stigma 3–5-lobum, extus scabridum, intus glabrum, obtusum vel attenuatum. *Ovarium* inferum, semi-inferum vel superum, obconicum vel hemisphæricum; placentæ axillares, carnosæ; ovuli ∞. *Capsula* 3–5-locularis, apice dehiscens, plurisperma; valvæ 3–5. *Semina* alata vel non alata, elliptica, oblonga vel ovoidea; testa levis brunneaque vel reticulata candidaque. *Embryo* axilis, teres, recta; albumen copiosum, carnosum; radicula juxta hilum.—*Glosocomia*, Don, Fl. Nep. p. 158.

Clavis Specierum.

Calyx inferus .... 1. *Tangshen.*
Calyx semisuperus.
  * Corolla supera.
    Folia ad apicem ramorum lateralium 3–4 fasciculata.
      Semina alata .... 2. *lanceolata.*
      Semina non alata .... 3. *ussuriensis.*
    Folia opposita vel alterna.
      Stamina setosa.
        Folia non excedentia 1 cm. longitudinis.
          Corolla 3–4 cm. longa; filamenta 16–17 mm. longa .. 4. *mollis.*
          Corolla 2–3 cm. longa; filamenta 10 mm. longa .... 5. *thalictrifolia.*
        Folia 6–10 cm. longa .... 6. *Benthami.*
      Stamina glabra.
        Corolla non excedens 9 mm. longitudinis .... 7. *micrantha.*
        Corolla saltem 17 mm. longa.
          Scandentes vel volubiles .... 8. *rotundifolia.*
          Non scandentes nec volubiles. Caules fertiles robusti, steriles numerosi a basi orti.
            Folia sinuata .... 9. *viridiflora.*

† [After this paper was read, and whilst it was still in the printers' hands, a critical revision of this genus was published by Mr. W. Komarov in Act. Hort. Petrop. vol. xxix. As far as it is necessary the new specific names published by him have been adopted.—T. F. C.]

Folia integra vel obscure serrata.
Folia 5–9 mm. longa .... 10. *fœtens.*
Folia 15–40 mm. longa .... 11. *ovata.*
Folia integra marginibus albidis crassis instructa .. 12. *cardiophylla.*
** Corolla semisupera.
Scandentes vel volubiles.
Stamina glabra.
Calycis lobi lineares, sinu obtuso saltem 5 mm. lati sejuncti .... 13. *viridis.*
Calycis lobi triangulares, sinu obtuso 1 mm. latitudinis non excedente sejuncti .... 14. *Henryi.*
Calycis lobi late ovati, sinu acuto sejuncti .... 15. *deltoidea.*
Stamina pilosa.
Ovarium pilosum .... 16. *tubulosa.*
Ovarium glabrum .... 17. *pilosa.*
Non scandentes nec volubiles.
Pedunculi primarii saltem 30 cm. longi .... 18. *subscaposa.*
Pedunculi primarii non excedentes 13 cm. longitudinis .. 19. *subsimplex.*
Calyx superus.
Corolla ad basin divisa .... 20. *convolvulacea.*
Corolla nunquam ultra dimidium divisa.
Calycis lobi sinu late obtuso sejuncti .... 21. *affinis.*
Calycis lobi sinu acuto sejuncti .... 22. *purpurea.*

1. Codonopsis Tangshen, *Oliver in Hook. f. Icon. Pl.* xx. (1891) t. 1966.—*Caules* volubiles, glabri. *Folia* alterna vel opposita, lanceolata, basi attenuata vel truncata, obtusa, obtuse serrata, pubescentia vel glabra, ciliata, 5–8 cm. longa, 2–3 cm. lata ; petioli glabri, 1–3 cm. longi. *Flores* solitarii, axillares, extra-axillares vel foliis oppositi ; pedunculi glabri, 3–4 cm. longi. *Calyx* inferus, fere ad basin divisus ; lobi oblongi, acuti, glabri, 18–24 mm. longi, 5–7 mm. lati. *Corolla* supera, campanulata, viridis, purpureis maculis instructa ; tubus glaber, 1·5–2 cm. longus, siccitate apice 2·5–3 cm. diam. ; lobi triangulares, acuti, 6–10 mm. longi, 6–10 mm. lati. *Filamenta* glabra, 7–8 mm. longa; antheræ glabræ, 4–5 mm. longæ. *Stylus* glaber, purpureus; stigma 3–5-lobum. *Ovarium* inferum, siccitate 5–14 mm. diam. ; loculi 3–5. *Capsula* conica, viridis vel purpurea, siccitate 2–2·5 cm. diam. *Semina* elliptica, levia, atro-brunnea, 1–1·5 mm. longa, 0·5–1 mm. lata.—Hemsl. in Journ. Linn. Soc., Bot. vol. xxxvi. (1904) p. 468 ; Skan, in Bot. Mag. t. 8090.

China : Hupeh, *Henry*, 6468 !, *Wilson*, 1623 !

The root of this species is extensively used for its medicinal properties, *vide* Oliver, *l. c.* The flowers have a rather disagreeable cabbage-like smell.

2. Codonopsis lanceolata, *Benth. & Hook. f. Gen. Plant.* vol. ii. (1876) p. 557.—*Caules* glabri vel sparsim pilosi. *Bracteæ* basi ramorum lateralium insertæ, lineari-lanceolatæ, 8–15 mm. longæ, 3–7 mm. latæ. *Folia* ad apices brevium lateralium ramorum fasciculata, lanceolata, acuta vel obtusa, basi

attenuata, integra vel grosse serrata, glabra, minute ciliata vel raro sparsim pilosa, 3·5–7·5 cm. longa, 2–3·5 cm. lata; petioli glabri, 1–5 mm. longi. *Flores* terminales; pedunculi glabri, 1–9 cm. longi. *Calyx* semisuperus; tubus hemisphæricus glaber, 3–10 mm. longus; lobi sinu acuto vel post anthesin obtuso sejuncti, lanceolati vel oblongi, acuti, glabri. *Corolla* supera, campanulata, glauco-viridis, purpureo-maculata; tubus glaber, 15–25 mm. longus, siccitate 15–25 mm. diam.; lobi reflexi, triangulares, acuti, 5–10 mm. longi, 5–10 mm. lati. *Filamenta* basi dilatata, glabra, 4–6 mm. longa; antheræ glabræ, 3–5 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 7–20 mm. diam. *Capsula* obconica, glauco-viridis, siccitate 20–25 mm. diam.; valvæ 3, 5–16 mm. longæ. *Semina* alata, levia, 2–3 mm. longa, 1 mm. lata; alæ lacteæ, 2–3 mm. longæ, 2 mm. latæ.—Trautv. in Act. Hort. Petrop. vol. vi. (1879) p. 46; Hance, in Journ. Bot. 1885, p. 325; Hemsl. in Journ. Linn. Soc., Bot. vol. xxvi. (1889) p. 5. *Glosocomia lanceolata*, Maxim. Mél. Biol. xii. p. 487. *Campanumæa lanceolata*, Sieb. & Zucc. Fl. Jap. i. p. 174, t. 91; Planch. in Fl. des Serres, t. 927; Walp. Repert. vol. ii. p. 710; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 11.

MANCHURIA: Frien Mts., *Faber*, 1611! between Hui Fa River and Kirin, *James*! Kirin to Tsitsihar, *James*! Coast of Manchuria, *Wilford*, 1196! between the mouths of the rivers Sungari and Ussuri, *Radde*! Sangatschi, *Maack*! CHINA: Pekin, *Bretschneider*, 477! Kew Kiang, *Shearer*! Shan Tung, *Faber*, 133! Ichang, *Henry*, 2342! Hupeh, *Henry*, 6527! Szechuen, *Henry*, 7248! *Wilson*, 2569! 1301! JAPAN: Central Mountains, 2000–7000 ft., *Maries*! Hakodate, *Maximowicz*! *Albrecht*! *Hodgson*! Gunassan, *Faurie*, 694! Mori, *Faurie*, 976! Sapporo, *Faurie*, 1333! Mt. Takao, *Takeda*, 301!

The root of this species is mentioned by Planch. *l. c.* as having a bitter taste, and is used for medicinal purposes.

3. CODONOPSIS USSURIENSIS, *Hemsl. in Journ. Linn. Soc., Bot.* vol. xxvi. (1889) p. 6.—*Caules* glabri vel ad nodos sparsim pilosi. *Bracteæ* basi ramorum lateralium glabræ vel pilosæ, lanceolatæ, acutæ, 15–25 mm. longæ, 5–10 mm. latæ. *Folia* ad apices brevium lateralium ramorum fasciculata, lanceolata vel elliptica, integra, acuta vel obtusa, basi attenuata, supra glabra, subtus glabra vel sparsim pilosa, minute ciliata, 3–5 cm. longa, 1·5–2·5 cm. lata; petioli glabri vel pilosi, 2–5 mm. longi. *Flores* terminales; pedunculi breves, glabri, 1–2 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, glaber, 15–25 mm. longus; lobi lanceolati, acuti, glabri, 1–2 cm. longi, 6–8 mm. lati. *Corolla* supera, campanulata; tubus 16–20 mm. longus, siccitate 2–2·5 cm. diam.; lobi triangulares, acuti, 5 mm. longi, 3–5 mm. lati. *Filamenta* glabra, basi parum dilatata, 4 mm. longa; antheræ glabræ, 2–3 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 8–15 mm. diam.

Capsula conica; valvæ 3, 5 mm. longæ. *Semina* atro-brunnea, minuta carina instructa, 2 mm. longa, 1 mm. lata.—*C. lanceolata*, var. *ussuriensis*, Trautv. in Act. Hort. Pet. vi. (1879) p. 47; var. β *obtusa*, Regel, in Bull. Phys.-Math. Acad. Pétersb. xv. (1857) p. 223. *Glosocomia ussuriensis*, Rupr. in Bull. Phys.-Math. Acad. Pétersb. xv. (1857) p. 209; Maxim. Prim. Fl. Amur. p. 184, et in Mél. Biol. xii. p. 487. *G. hortensis*, Rupr. in Bull. Phys.-Math. Acad. Pétersb. xv. (1857) p. 209.

MANCHURIA: Amur, *Maximowicz*!

4. CODONOPSIS MOLLIS, *Chipp.*—*Caules* fertiles, subrobusti, pilosi, circ. 17 cm. longi; steriles graciles, dense pilosi, circ. 7 cm. longi. *Folia* alterna vel opposita, subsessilia, ovata, basi subcordata, obtusa, integra, dense hirsuta, 8–10 mm. longa, 7–10 mm. lata. *Flores* terminales; pedunculi sparsim pilosi, circ. 3 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, sparsim pilosus, circ. 3 mm. longus; lobi sinu obtuso sejuncti, ovati, apice dense hirsuti, 5 mm. longi, 3–4 mm. lati. *Corolla* supera, cylindrico-infundibuliformis; tubus venis sparsim hirsutus, 38 mm. longus, siccitate basi 8 mm. diam., apice 20 mm. diam.; lobi triangulares, acuti, glabri, 5 mm. longi, 7 mm. lati. *Filamenta* basi parum dilatata, glabra, 16–17 mm. longa; antheræ carinatæ 6 mm. longæ; carinæ setis vestitæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate circ. 10 mm. diam.

TIBET: Hills above Lhassa, *Capt. Walton*!

I have not seen the fruit of this species. It differs from *C. thalictrifolia* in having a longer corolla, longer filaments, and more hirsute and larger leaves.

5. CODONOPSIS THALICTRIFOLIA, *Wall. in Roxb. Fl. Ind.* vol. ii. p. 106. —*Caules* fertiles subrobusti, sparsim pilosi vel glabri, 20–30 cm. longi; steriles gracillimi, pilosi, 4–6 cm. longi. *Folia* opposita vel alterna, rotundata, basi subcordata vel truncata, integerrima, dense hirsuta vel scabrida, 3–5 mm. longa, 3–5 mm. lata; petioli hirsuti, raro 2 mm. longi. *Flores* terminales; pedunculi pilosi vel breviter hirsuti, 3–16 cm. longi. *Calyx* semisuperus, hemisphæricus; tubus glaber vel minute scabridus, 3–4 mm. longus; lobi sinu subobtuso sejuncti, oblongi, obtusi, integri, minute scabridi, 6–7 mm. longi, 2–3 mm. lati. *Corolla* supera, cylindrico-infundibuliformis, cærulea; tubus glaber, 18–23 mm. longus, siccitate basi 6–9 mm. diam., apice 15–23 mm. diam.; lobi triangulares, subobtusi, integri, 3–4 mm. longi, 7–9 mm. lati. *Filamenta* basi parum dilatata, glabra, 1 cm. longa; antheræ carinatæ, 3 mm. longæ; carinæ setis vestitæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 6–10 mm. diam. *Capsula* (?) conica.—Benth. in Royle, Illustr. Bot. Himal. p. 253; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 16; Hook. f. Fl. Br. Ind. vol. iii. p. 432. *Glosocomia tenera*, D. Don, Prod. Fl. Nepal. p. 158. *G. thalictrifolia*, Wall. Cat. n. 1297. *Wahlen-*

bergia thalictrifolia, DC. Prodr. vol. vii. p. 425. *Campanula thalictrifolia*, Spreng. Cur. post. p. 77.

TIBET: Herb. Hort. Bot. Calcutt.! INDIA: Nepal, Gossain Than, *Wallich*!

I have not seen this species in fruit.

6. CODONOPSIS BENTHAMI, *Hook. f. & Thoms. in Journ. Linn. Soc.* vol. ii. (1858) p. 14.—*Caules* robusti, pilosi. *Folia* opposita vel alterna, ovata vel lanceolata vel deltoidea, basi truncata vel attenuata, subobtusa vel acuta, grosse serrata, breviter hirsuta, 6–10 cm. longa, 4–5·5 cm. lata; petioli sparsim pilosi, 20–35 mm. longi. *Flores* terminales; pedunculi pilosi, 2–8 cm. longi. *Calyx* semisuperus; tubus hemisphæricus vel obconicus, glaber, 3–6 mm. longus; lobi imbricati, rotundati vel late ovati, breviter acuminati, ciliati, 10–12 mm. longi, 10–12 mm. lati. *Corolla* supera, campanulato-cylindrica; tubus glaber, 15–20 mm. longus, siccitate 8–12 mm. diam.; lobi triangulares, acuti, glabri, 3–5 mm. longi, 3–5 mm. lati. *Filamenta* e basi glabra dilatata, subulata, densissime pilosa, 7 mm. longa; antheræ carinatæ, 4 mm. longæ; carinæ setis vestitæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 8–13 mm. diam. *Capsula* conica; valvæ 3, 6–8 mm. longæ. *Semina* oblonga, 1 mm. longa, 0·5–0·8 mm. lata.

INDIA: Sikkim, 9000–11,000 ft., *J. D. Hooker*! *Clarke*, 9879 A! 10001! 10224 A! Sikkim frontier, Sim-doong-tang, *Dungboo*!

Hooker mentions this plant as having "a heavy, almost rank, hircine smell."

7. CODONOPSIS MICRANTHA, *Chipp.*—*Caules* glabri, ad nodos pilosi. *Folia* opposita vel alterna, ovata, basi cordata, acuta vel obtusa, grosse serrata, sparsim pilosa, 5–8 cm. longa, 2·5–3 cm. lata; petioli glabri vel sparsim pilosi, 2–4 cm. longi. *Flores* axillares; pedunculi glabri, 1–2 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, glaber, 5–7 mm. longus; lobi sinu acuto sejuncti, triangulares, acuti, glabri vel minute ciliati, 12–14 mm. longi, 4–5 mm. lati. *Corolla* supera campanulata; tubus glaber, 4–5 mm. longus, siccitate 7–9 mm. diam.; lobi triangulares, glabri vel ciliati, acuti, 3–4 mm. longi, 2–3 mm. lati. *Filamenta* glabra, basi dilatata, 3 mm. longa; antheræ glabræ, 2 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, glabrum, siccitate 6–7 mm. diam. *Capsula* conica; valvæ 3 mm. longæ. *Semina* ovoidea, levia, candida, 1 mm. longa, 0·5 mm. lata.

CHINA: Yunnanfu, *Ducloux*, 513!

This species differs from *C. ovata*, Benth., in having deeply cordate, coarsely serrate leaves, long petioles, and the corolla under 10 mm. long.

8. CODONOPSIS ROTUNDIFOLIA, *Royle, Illustr. Bot. Himal.* p. 254, t. 62.—*Caules* glabri vel pilosi. *Folia* opposita vel alterna, rotundata vel ovata, basi truncata vel cordata, grosse serrata, obtusa vel subacuta, glabra vel ad venas sparsim hirsuta, 4–8 cm. longa, 3–6·5 cm. lata, petioli hirsuti, 1–3 cm. longi.

Flores foliis oppositi; pedunculi glabri vel sparsim hirsuti, 1–3 cm. longi. *Calyx* semisuperus; tubus obconicus, glaber, 3–5 mm. longus; lobi sinu acuto sejuncti, ovati, acuti vel subacuti, integri vel grosse serrati, glabri vel hirsuti, ciliati, 14–16 mm. longi, 8–11 mm. lati. *Corolla* supera, campanulata, pallide cærulea, lilacinis purpureis maculis instructa; tubus glaber, 14–17 mm. longus, siccitate ad apicem 17–22 mm. diam.; lobi late triangulares, acuti, 5–6 mm. longi, 7–10 mm. lati. *Filamenta* basi dilatata, glabra, circ. 4 mm. longa; antheræ glabræ, circ. 3 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 10–12 mm. diam. *Capsula* conica; valvæ 3, 8–10 mm. longæ. *Semina* oblonga, candida, 2 mm. longa, 0·8–1 mm. lata.—Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 14; Hook. f. Fl. Brit. Ind. iii. p. 432; Bot. Mag. tt. 4942, 5018; Ic. Cathcart, ined. in Herb. Kew. *C. lurida*, Lindl. in Bot. Reg. 1839, Misc. 82. *Wahlenbergia rotundifolia*, A. DC. Prodr. vol. vii. p. 425. *C. silvestris*, Kom. in Act. Hort. Petrop. xviii. p. 425; Hemsl. in Journ. Linn. Soc., Bot. vol. xxvi. (1889) p. 468.

Manchuria: Sungari River, Tang-ho-ko, and Chang-pei-shan, *James*! India: Scinde Valley, *Clarke*, 27188 A! Kashmir, *Clarke*, 24242! 29356! 30827! 31113! 31126! 31322! Himalaya, *Edgeworth*, 240! 6000–7000 ft., *Thomson*! Kumaon, *Strachey & Winterbottom*, 2! Chamba, *Ellis*, sheet XLVI.! Kulu, *Edgeworth*, 5043!

The variety *grandiflora*, Hook. in Bot. Mag. 5018, I have not considered sufficiently distinct to retain.

9. Codonopsis viridiflora, *Maxim. in Bull. Acad. Pétersb.* xxvii. (1881) p. 496.—*Caules* sparsim hirsuti. *Folia* alterna, ovata vel lanceolata, basi subcordata, sinuata, obtusa, breviter setosa, 15–35 mm. longa, 13–25 mm. lata; petioli hirsuti, 7–10 mm. longi. *Flores* terminales; pedunculi glabri vel sparsim hirsuti, 6–13 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, ovario omnino adnatus, glaber, circ. 3 mm. longus; lobi sinu acuto sejuncti, ovati, grosse serrati vel sinuati, obtusi, ciliati, apice minute setosi, 12–15 mm. longi, 6–7 mm. lati. *Corolla* supera, campanulata, luteoviridis; tubus glaber, circ. 1 mm. longus, siccitate circ. 15 mm. diam.; lobi late triangulares, subobtusi, circ. 7 mm. longi, circ. 7 mm. lati. *Filamenta* glabra, basi dilatata, 5 mm. longa; antheræ glabræ, 5 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* (semi-inferum ?), siccitate circ. 13 mm. diam.

China: Kansu, *Przewalski*!

10. Codonopsis fœtens, *Hook. f. et Thoms. in Journ. Linn. Soc.* vol. ii. (1858) p. 16.—*Caules* fertiles subrobusti, pilosi, 30–50 cm. longi; steriles gracillimi, densissime pilosi, 4–7 cm. longi. *Folia* alterna vel opposita, rotundata, basi truncata vel subcordata, obtusa, integerrima, densissime setosa, 5–9 mm. longa, 5–10 mm. lata; petioli setosi, raro 2 mm. longi. *Flores* terminales;

pedunculi glabri vel pilosi, sæpe bractea instructa, 4–20 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, sparsim pubescens vel pilosus, 3–4 mm. longus; lobi sinu obtuso sejuncti, lanceolati vel oblongi, acuti, integri, sinuati vel serrati, extus dense intus sparsim pilosi, 7–13 mm. longi, 2·7 mm. lati. *Corolla* supera, campanulata; tubus glaber, 10–15 mm. longus, siccitate 20–30 mm. diam.; lobi late triangulares, acuti vel obtusi, 5 mm. longi, 7–10 mm. lati. *Filamenta* glabra, basi dilatata, 3 mm. longa; antheræ glabræ, 4 mm. longæ. *Stylus* glaber; stigma 3-lobum. *Ovarium* post anthesin semi-inferum, siccitate 10–15 mm. diam. *Capsula* conica; valvæ 3, 11–15 mm. longæ. *Semina* oblonga, levia, 1·5–2 mm. longa, 0·8–1 mm. lata. —Hook. f. Fl. Br. India, vol. iii. p. 433.

TIBET: near Choun, *King's collector*! Chumbi and Phari, Sham Chen, and 18 miles N.W. of Chumbi, *Dungboo*! Yatung, *Hobson*! INDIA: Sikkim, 14,000–16,000 ft., *Hooker f.*! CHINA: Tachienlu, *Soulié*, 125! 540! *Pratt*, 531!

11. CODONOPSIS OVATA, *Benth. in Royle, Illust. Bot. Himal.* p. 253, tab. 69, fig. 3.—*Caules* fertiles robusti, glabri vel pilosi, 30–50 cm. longi; steriles graciles, glabri vel pilosi, 4–13 cm. longi. *Folia* opposita vel alterna, ovata, lanceolata vel elliptica, obtusa vel acuta, basi truncata, subcordata vel attenuata, integra vel obscure serrata, densissime hirsuta vel sparsim pubescentia, ciliata, 15–40 mm. longa, 10–25 mm. lata; petioli pubescentes vel hirsuti, 1–8 mm. longi. *Flores* 1–3, terminales; pedunculi hirsuti, pilosi vel glabri, 5–17 cm. longi. *Calyx* semisuperus; tubus hemisphæricus, ovario omnino adnatus, pilosus vel glaber, 3–5 mm. longus; lobi imbricati, sinu acuto sejuncti, ovati vel oblongi, acuti vel obtusi, integri, glabri vel pilosi vel hirsuti, ciliati, 7–13 mm. longi, 4–7 mm. lati. *Corolla* supera, campanulato-infundibuliformis, dilute cærulea, maculis brunneis aurantiacis viridibus lilacinis notata; tubus glaber, 15–21 mm. longus, siccitate basi 7–10 mm. faucibus 17–25 mm. diam.; lobi ovati, subobtusi vel acuti, glabri, 5–10 mm. longi, 7–10 mm. lati. *Filamenta* subulata, basi subdilatata, glabra, 1–4 mm. longa; antheræ glabræ, 3–4 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, glabrum, siccitate 7–10 mm. diam. *Capsula* conica; valvæ 3, 8–10 mm. longæ. *Semina* levia, 1·5–2 mm. longa, 0·8–1 mm. lata.—Lindl. in Gard. Chron. 1856, p. 468, cum icon.; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 15; Hook. f. Fl. Brit. Ind. vol. iii. p. 433; Journ. Hort. ser. 3, xxvii. (1893) 273, cum icon.; Trautv. in Act. Hort. Petrop. vi. (1879) 47. *Wahlenbergia Roylei*, A. DC. Prodr. vol. vii. p. 425. *W. clematidea*, Schrenk, Enum. Pl. Soong. vol. v. p. 38. *Glosocomia clematidea*, Fisch. in Regel, Gartenfl. 1856, p. 226, tab. 167, f. 2.

INDIA: Kashmir, *Falconer*, 618! 9–500 ft., *Thomson*! *Aitchison*, 5! 60! *Clarke*, 29251 B! Sousal nala, *Duthie*, 13355! Chamba, Pangi Valley, *Ellis*, 5! Punjab-Himalaya, Lahul, *Jaeschke*, 50!

Var. CUSPIDATA, *Chipp.* *Calycis tubus* totus ovario adnatus; lobi sinu acuto sejuncti, 10–17 mm. longi. *Corolla* campanulata ; tubus siccitate 20–30 mm. diam. ; lobi cuspidati.

AFGHANISTAN : Kuram Valley, *Aitchison*, p.p. 748 ! TURKESTAN : in montibus Alatau, *Karelin & Kiriloff*, 1702 ! *Semenov* ! in montibus Alexander, 7000 ft., *Fetissow* ! prope Wernoje, *Kuschockewicz & Fetissow* ! prope fl. Muzart, *Krassnow*, a. 1886 ! Zagan-tunge, *Regel* (in herb. Mus. Brit. non in herb. Kew. !); Kok-su Valley, Thian-Shan, *Littledale* ! INDIA : Ladak, 9000–11,000 ft., *Thomson*, n. 1848 ! *Cordeaux* ! Kashmir, *Clarke*, 29478 ! Lahul, Bhaya Valley, *Schlagintweit* ! Surro-Sanko, *Dr. Holdsworth* ! CHINA : Tachienlu, *Soulié*, 593 !

Var. OBTUSA, *Chipp.* *Calycis tubus* ovario omnino adnatus ; lobi sinu obtuso sejuncti. *Corolla* campanulata ; lobi cuspidati.

AFGHANISTAN : Kuram Valley, *Aitchison*, p.p. 748 ! *Griffith*, 3435 ! TURKESTAN : Zagan-tunge, *Regel* (in herb. Kew., non in herb. Mus. Brit. !).

Var. NERVOSA, *Chipp.* *Calycis tubus* paululo ultra ovarium productus, superne nervorum anamostosantium annulo instructus, 3–4 mm. longus; lobi sinu obtuso sejuncti. Corolla campanulata ; lobi triangulares, acuti.

CHINA : *Wilson*, 3984 ! Tachienlu, *Pratt*, 632 !

Owing to the remarkable degree of variation presented by the leaves, as is shown by material recently received, I have been unable to retain the varieties *β. ramosissima*, Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 15, and *glabrata*, Hook. f. MSS., which were founded on these characters. Lindley mentions this species as having a strong " hircine smell."

12. CODONOPSIS CARDIOPHYLLA, *Diels, ex Kom. in Act. Hort. Petrop.* xxix. (1908) p. 117.—*Caules* fertiles robusti, glabri vel sparsim pilosi, 40–50 cm. longi ; steriles subrobusti, glabri, 10–17 cm. longi. *Folia* opposita vel alterna, ovata vel lanceolata, basi cordata, obtusa, integra, supra glabra, subtus ad venas sparsim pilosa, 2–3 cm. longa, 2–2·5 cm. lata, marginibus albis crassis; petioli glabri vel hispidi, raro 2 mm. longi. *Flores* 1–4, terminales ; pedunculi glabri vel pilosi, 6–12 cm. longi. *Calyx* semisuperus ; tubus hemisphæricus, glaber, 4–5 mm. longus ; lobi sinu acuto sejuncti, late lanceolati vel triangulares, obtusi, integri, glabri vel pubescentes, 10–12 mm. longi, 4–5 mm. lati. *Corolla* supera, campanulata, purpureo-maculata ; tubus glaber vel sparsim pilosus, 15–17 mm. longus, siccitate 20–22 mm. diam. ; lobi ovati, acuti, pilosi, 10–12 mm. longi, 10 mm. lati. *Filamenta* linearia, basi dilatata, glabra, 6–7 mm. longa ; antheræ glabræ, 5 mm. longæ. *Stylus* glaber ; stigma 3-lobum. *Ovarium* semi-inferum. *Capsula* conica, siccitate 8–10 mm. diam. ; valvæ 5–7 mm. longæ. *Semina* levia, 1–1·5 mm. longa, 0·5 mm. lata.

CHINA : Hupeh, *Wilson*, 2381 !

This species differs from *C. ovata*, Benth., in having a thickened white margin to the leaves.

13. CODONOPSIS VIRIDIS, *Wall. in Roxb. Fl. Ind. ed. Carey*, vol. ii. p. 103.—*Caules* volubiles, glabri vel minute pubescentes. *Folia* opposita vel alterna, lanceolata, basi attenuata vel subtruncata, acuta, integra, supra minute pubescentia, subtus dense pubescentia, 5–10 cm. longa, 2·5–5 cm. lata; petioli dense pubescentes, 1–2 cm. longi. *Flores* foliis oppositi vel suboppositi; pedunculi pilosi, 3–7 cm. longi. *Calyx* superus; tubus hemisphæricus, minute pubescens, 6–9 mm. longus; lobi sinu obtuso saltem 5 mm. late sejuncti, lineares, acuti, dense pubescentes, 10–17 mm. longi, 1–1·5 mm. lati. *Corolla* semisupera, late campanulata, pallide viridis, luteis purpureis maculis instructa; tubus breviter hirsutus, 20–23 mm. longus, siccitate 25–30 mm. diam.; lobi late triangulares, acuti, 1 cm. longi, 1 cm. lati. *Filamenta* basi dilatata, glabra, 5–6 mm. longa; antheræ glabræ, 5–6 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* inferum, siccitate 15–20 mm. diam. *Capsula* conica; valvæ 3, 5 mm. longæ. *Semina* candida, 1 mm. longa, 0·5 mm. lata.—Wall. Cat. 1298; A. DC. Monogr. Camp. p. 120; Hook. f. Fl. Br. Ind. vol. iii. p. 431; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 12. *Campanula viridis*, Spreng. Cur. Post. p. 78. *Wahlenbergia viridis*, A. DC. Prodr. vol. vii. p. 425.

INDIA: Nepal, *Wallich*! Kumaon, *Wallich*! 7000 ft. *Madden*! *Strachey & Winterbottom*! Garhwal, Shioli, *Edgeworth*!

Var. HIRSUTA, *Chipp*. *Folia* dense hirsuta.—Griffith, Notulæ, vol. iv. p. 281, no. 3; et Ic. Pl. As. pl. 482. *C. Griffithii*, Clarke, in Fl. Brit. Ind. vol. iii. p. 431.

INDIA: Khasia, 5000–6000 ft., *Hook. f. & Thoms.*! *Lobb*! *Clarke*, 6300! 16304! 44896!

This plant does not appear to me to be specifically different from *C. viridis*, Wall., and Clarke himself states that it may be only a geographical variety. The seeds generally glisten as in *C. viridis*; but this appears to be a variable character.

14. CODONOPSIS HENRYI, *Oliver, in Hook. Icon. Pl.* vol. xx. (1891) t. 1967.—*Caules* glabri vel ad nodos pubescentes. *Folia* alterna vel opposita, lanceolata, basi attenuata, acuminata, grosse serrata, pubescentia, 9–14 cm. longa, 3–6 cm. lata; petioli pubescentes, 10–18 mm. longi. *Flores* axillares; pedunculi glabri vel pubescentes, 7–30 mm. longi. *Calyx* semisuperus; tubus glaber vel pubescens, 4–6 mm. longus; lobi reflexi, sinu obtuso sejuncti, triangulares, acuti, pubescentes, ciliati, 10 mm. longi, 3–7 mm. lati. *Corolla* semisupera, tubuloso-campanulata, extus purpurea, intus albida; tubus glaber vel pubescens, 17 mm. longus, siccitate apice 20 mm. diam.;

lobi triangulares, acuti, 6–7 mm. longi, 6–7 mm. lati. *Filamenta* basi dilatata, glabra, 7 mm. longa ; antheræ glabræ, 5 mm. longæ. *Stylus* glaber; stigma 3-lobum. *Ovarium* semi-inferum, siccitate 10–11 mm. diam.

CHINA : Hupeh, *Henry*, 6651 !

I have not seen the fruit of this species.

15. CODONOPSIS DELTOIDEA, *Chipp.*—*Caules* glabri vel sparsim pilosi. *Folia* opposita, ovata, basi truncata vel subcordata, obtuse acuminata, obtuse grosse serrata, sparsim pilosa vel hirsuta, 7–10 cm. longa, 5–10 cm. lata; petioli pilosi vel hirsuti, 3–8 cm. longi. *Flores* axillares ; pedunculi pilosi, 1–2 cm. longi. *Calyx* semisuperus ; tubus glaber, 2–3 mm. longus; lobi sinu subobtuso sejuncti, triangulares, acuti, glabri, ciliati, 6–15 mm. longi, 3–5 mm. lati. *Corolla* semisupera, cylindrica ; tubus basi ovario non adnatus, glaber, 15 mm. longus, siccitate 10–15 mm. diam. ; lobi triangulares, acuti, 4 mm. longi, 5 mm. lati. *Filamenta* subulata, ad basin parum dilatata, glabra, 6 mm. longa ; antheræ glabræ, 3 mm. longæ. *Stylus* glaber ; stigma 4–5-lobum. *Ovarium* semi-inferum, siccitate 8–10 mm. diam. *Capsula* conica ; valvæ 4–5, 6–9 mm. longæ. *Semina* ovoidea, candidissima, 1 mm. longa, 0·7 mm. lata.

CHINA : Mt. Omi, *Wilson*, 3988 ! 5035 !

This species differs from *C. Benthami*, Hook. f. & Thoms., in having perfectly glabrous stamens and axillary flowers.

16. CODONOPSIS TUBULOSA, *Kom. in Act. Hort. Petrop.* xxix. (1908) p. 112. —*Caules* glabri vel ad nodos pilosi. *Folia* alterna vel opposita, lanceolata, basi attenuata vel subtruncata, obtusa, integra vel minute serrata, supra pubescentia, subtus dense pubescentia, 6–8 cm. longa, 3–4 cm. lata ; petioli pilosi, 2–5 mm. longi. *Flores* 1–3 terminales ; pedunculi pilosi, 2–12 cm. longi. *Calyx* semisuperus ; tubus obconicus vel hemisphæricus, glaber, 3–5 mm. longus ; lobi imbricati, sinu acuto sejuncti, ovati, obtusi, glabri vel sparsim pilosi, ciliati, 7–11 mm. longi, 6–10 mm. lati. *Corolla* semisupera, tubulosa ; tubus glaber, 20–22 mm. longus, siccitate 6–10 mm. diam. ; lobi triangulares, acuti, 4–5 mm. longi, circ. 5 mm. lati. *Filamenta* ciliata, basi glabra dilatata, 10–11 mm. longa; antheræ carinatæ 3–4 mm. longæ ; carina setis cristata. *Stylus* subglaber vel pilosus ; stigma 3-lobum; lobi attenuati. *Ovarium* semi-inferum, densissime pilosum, siccitate 10–15 mm. diam. *Capsula* conica ; valvæ 3, 10–12 mm. longæ. *Semina* levia, 1–1·5 mm. longa, 0·5–0·8 mm. lata.

CHINA : Yunnan, *Henry*, 10167 A !

This species differs from *C. pilosa*, Chipp, in having a pilose style and ovary, and having the undersurface of the veins of the leaves subglabrous ; and from *C. affinis*, Hook. f. & Thoms., in having a tubular corolla and an acute sinus between the calyx-lobes.

17. Codonopsis pilosa, *Chipp.*—*Caules* glabri vel ad nodos sparsim hirsuti. *Folia* opposita vel alterna, lanceolata, subacuta, basi attenuata, integra vel minute crenata, hirsuta, circ. 5 cm. longa, circ. 3 cm. lata ; petioli glabri vel hirsuti, 3–4 mm. longi. *Flores* terminales ; pedunculi hirsuti, 16–35 mm. longi. *Calyx* semisuperus ; tubus obconicus, glaber, 2–3 mm. longus ; lobi imbricati, sinu acuto sejuncti, ovati, subobtusi, glabri, dense ciliati, 8–10 mm. longi, 5–6 mm. lati. *Corolla* supera, tubulosa ; tubus glaber, 3 cm. longus, siccitate basi 7–8 mm. diam., apice circ. 15 mm. diam. ; lobi triangulares, 4–5 mm. longi, 6–7 mm. lati. *Filamenta* e basi glabra dilatata subulata, densissime pilosa, 13–14 mm. longa ; antheræ muticæ, carinatæ, 5–6 mm. longæ ; carina setis cristata. *Stylus* basi glaber, supra densissime pilosus ; stigma 3-lobum ; lobi attenuati. *Ovarium* semi-inferum, siccitate 10 mm. diam. *Capsula* conica.

China : Yunnan, *Hancock*, 379 !

I have not seen the mature fruit of this species. The species is distinguished from *C. tubulosa*, Kom., by its glabrous ovary, but more densely pilose style and filaments, and by having a line of setæ along the undersurface of the leaf-veins.

18. Codonopsis subscaposa, *Kom. in Act. Hort. Petrop.* xxix. (1908) p. 114.—*Caules* fertiles robusti, pilosi, 40–80 cm. longi; steriles gracillimi, pilosi, non excedentes 7 cm. *Folia* alterna, elliptica vel lanceolata vel ovata, obtusa, grosse serrata, hirsuta, 5–8 cm. longa, 2–3 cm. lata ; petioli sparsim hirsuti, 1·5–3 cm. longi. *Flores* terminales ; pedunculi primarii robusti, glabri vel sparsim pubescentes, 30–90 cm. longi; bracteæ lanceolatæ, obtusæ, minute ciliatæ vel hirsutæ, 1–2 cm. longæ. *Calyx* semisuperus ; tubus sparsim pubescens, 5–7 mm. longus ; lobi lanceolati, obtusi, serrati, apice minute scabridi, 7 mm. longi, 3 mm. lati. *Corolla* semisupera, infundibuliformi-campanulata ; tubus glaber, circ. 13 mm. longus, siccitate fauce circ. 20 mm. diam. ; lobi triangulares, acuti, ciliati, 1 cm. longi, 1 cm. lati, siccitate apice 2·5–3 cm. diam. *Filamenta* glabra, 5–6 mm. longa ; antheræ glabræ, 4–5 mm. longæ. *Stylus* glaber ; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 1 cm. diam. *Capsula* conica.

China : Tachienlu, 9000–13,500 ft., *Pratt*, 474 ! Kiala, Tongolo, *Soulié*, 426 ! 11,000–12,500 ft., *Wilson*, 3985 !

I have not seen the mature fruit of this species.

19. Codonopsis subsimplex, *Hook. f. & Thoms. in Journ. Linn. Soc.* vol. ii. (1858) p. 16.—*Caules* glabri vel ad nodos pubescentes. *Folia* opposita vel alterna, ovata vel lanceolata, basi attenuata vel truncata, grosse serrata vel crenata, acuta vel subobtusa, 3–5 cm. longa, 2–3 cm. lata ; petioli glabri vel pubescentes, 10–20 mm. longi. *Flores* 1–3 terminales ; pedunculi glabri, 6–13 cm. longi. *Calyx* semisuperus ; tubus glaber, 1 cm. longus ; lobi

imbricati, sinu acuto sejuncti, lanceolata vel ovata, acuta vel subacuminata, serrata, glabra, 13–15 mm. longa, 5–10 mm. lata. *Corolla* semisupera, cylindrico-campanulata, lutea, viridibus albidisque maculis notata; tubus glaber, 11–12 mm. longus, siccitate apice 10–12 mm. diam.; lobi triangulares, acuti vel subobtusi, 2–3 mm. longi, 3–5 mm. lati. *Filamenta* glabra, 6 mm. longa; antheræ glabræ, 4 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* semi-inferum, siccitate 11–12 mm. diam. *Capsula* conica; valvæ 3, circ. 5 mm. longæ. *Semina* levia, atro-brunnea, 1–1·5 mm. longa, 0·8–1 mm. lata.—Hook. f. Fl. Brit. India, vol. iii. p. 432.

TIBET: Chumbi, Gook, *Dungboo*! Yatung, *Hobson*! INDIA: Sikkim, 12,000–13,000 ft., *Hooker f.*! Darjeeling, Singalela, *Clarke*, 12542! 13450!

20. CODONOPSIS CONVOLVULACEA, *Kurz, in Journ. Bot.* vol. xi. (1873) p. 195.—*Caules* volubiles, glabri. *Folia* opposita vel alterna, ovata vel lanceolata, basi attenuata vel cordata, obtusa, glabra vel sæpe minute ciliata, 20–50 mm. longa, 4–30 mm. lata; petioli glabri, 2–12 mm. longi. *Flores* terminales; pedunculi glabri, 2–12 cm. longi. *Calyx* superus; tubus obconicus, glaber, 3–7 mm. longus; lobi sinu subobtuso vel acuto sejuncti, triangulares vel lanceolati, acuti vel subobtusi, glabri vel minute ciliati, 4–11 mm. longi, 1–5 mm. lati. *Corolla* supera, campanula, cærulea, fere ad basin divisa, siccitate 25–40 mm. diam.; lobi triangulares vel oblanceolati, acuti vel sæpe minutissime mucronati, 10–33 mm. longi, 6–12 mm. lati. *Filamenta* ad basin dilatata et intus appendice ciliata instructa, cætera glabra, 1–2 mm. longa; antheræ glabræ, 1–5 mm. longæ. *Stylus* glaber; stigma 3-lobum. *Ovarium* inferum, siccitate 4–10 mm. diam. *Capsula* truncata vel subconica; valvæ 3, circ. 4 mm. longæ. *Semina* brunnea, 1·5 mm. longa, 0·5 mm. lata.—Hook. Ic. Pl. vol. xxiv. t. 2385; Hemsl. in Journ. Linn. Soc. vol. xxxvi. (1904) p. 468; Bot. Mag. t. 8178. *C. vinciflora*, Kom. in Act. Hort. Petrop. xxix. (1908) p. 103.

CHINA: Yunnan, Mengtze, 5000–6500 ft., *Hancock*, 74! 385! 4500 ft., *Wilson*, 3986! between Batang and Tachienlu, *Consul-General Hosie*! TIBET: Tsanypo Valley, 13,000 ft., *Waddell*! *Walton*! Lhassa, *Dungboo*! BURMA: Shan States, Koni district, 4000 ft., *Collett*, 917! *Melville*, 45!

Wilson's No. 9425 at Kew, from Yunnan, China, consists of three stems, two bearing leaves only and one flowers only. If these are from the same plant this will be a new species allied to *C. convolvulacea*, Kurz.

21. CODONOPSIS AFFINIS, *Hook. f. & Thoms. in Journ. Linn. Soc.* vol. ii. (1858) p. 12.—*Caules* glabri vel ad nodos pubescentes. *Folia* alterna, ovata vel lanceolata, basi cordata, acuta vel acuminata, sinuosa vel dentata, supra pubescentia, subtus dense pubescentia vel tomentosa, 4–8 cm. longa, 4–6 cm. lata; petioli dense pubescentes vel pilosi, 15–30 mm. longi. *Flores* foliis

oppositi; pedunculi pubescentes, raro 25 mm. longi. *Calyx* superus, dense pubescens, 5 mm. longus; lobi sinu obtuso sejuncti, triangulares, acuti, dense pubescentes, 5–6 mm. longi, 3 mm. lati. *Corolla* supera, campanulata, viridis purpureis maculis notata; tubus pubescens, 8 mm. longus, siccitate apice 15 mm. diam.; lobi late triangulares, acuti, pubescentes, 3 mm. longi, 4–5 mm. lati. *Filamenta* basi dilatata, glabra, 2 mm. longa; antheræ glabræ, 1 mm. longæ. *Stylus* glaber; stigma late 3–5-lobum. *Ovarium* inferum, siccitate 8–10 mm. diam. *Capsula* conica, siccitate 10–13 mm. diam.; valvæ 3, 3–5 mm. longæ. *Semina* ovoidea, levia, brunnea vel candida, 0·8–1 mm. longa, 0·5–0·8 mm. lata.—Hook. f. Fl. Brit. Ind. vol. iii. p. 431. Var. *birmanica*, Clarke, Hook. f. l. c. (?).

INDIA: Sikkim, 6000–10,000 ft., *Hook. f.*! *Clarke*, 12897! 13003! 25551! 25560! 25605!

I have not considered it necessary to retain the var. *birmanica*, Clarke. The only material is one imperfectly fruiting specimen in Herb. Kew.

22. CODONOPSIS PURPUREA, *Wall. in Roxb. Fl. Ind. ed. Carey*, vol. ii. p. 105.—*Caules* scandentes vix volubiles, glabri. *Folia* opposita vel pedunculis opposita, lanceolata, basi attenuata, acuta vel obtusa, glabra, subtus glauca, 4–9 cm. longa, 2–3·5 cm. lata; petioli glabri, raro 5 mm. longi. *Flores* terminales vel foliis oppositi; pedunculi glabri, 1–7 mm. longi. *Calyx* superus; tubus obconicus, glaber, per anthesin 6–10 mm. longus; lobi sinu acuto sejuncti, triangulares vel oblongi, acuti, glabri, 10–17 mm. longi, 6–9 mm. lati. *Corolla* supera, campanulata, atro-purpurea, extus glauca; tubus glaber, 12–15 mm. longus, siccitate fauce 15–22 mm. diam.; lobi triangulares vel suboblongi, acuti, 8–15 mm. longi, 8–10 mm. lati. *Filamenta* basi dilatata, glabra, 6 mm. longa; antheræ glabræ, 5 mm. longæ. *Stylus* glaber; stigma late 3-lobum. *Ovarium* inferum, siccitate 10–15 mm. diam. *Capsula* subconica, siccitate 15–20 mm. diam.; valvæ 3, 5–8 mm. longæ. *Semina* flava, alata, 2 mm. longa, 1 mm. lata; alæ 2 mm. longæ, 1 mm. latæ. —Wall. Cat. 1299; A. DC. Monogr. Camp. p. 121; Hook. f. & Thoms. in Journ. Linn. Soc. vol. ii. (1858) p. 12; Hook. f. Fl. Brit. Ind. vol. iii. p. 431; Strachey & Duthie, Cat. Pl. Kumaon, p. 102. *Campanula purpurea*, Spreng, Cur. Post. p. 78. *Wahlenbergia purpurea*, A. DC. Prodr. vol. vii. p. 425.

INDIA: Nepal, Gossain Than, *Wallich*! Kumaon, Lohathal, 6000 ft., *Strachey & Winterbottom*! Naini Tal, *Miss Wall*! Khasia, Lailanhote, 5000 ft., *Clarke*, 44864! *Collett*!

The flowers of this species are mentioned by Wallich, *l. c.*, as being fetid.

SPECIES DUBIÆ.

Codonopsis japonica, Miquel, in Ann. Mus. Bot. Lugd.-Bat. vol. ii. p. 192.

Owing to the very imperfect description and the absence of material, it is uncertain whether this plant belongs to this genus or not. The only specimen mentioned is that collected by Keiske in Japan.

Species excludendæ.

Codonopsis albiflora, Griff. Not. iv. 279 = *Campanumœa celebica.*
Codonopsis celebica, Miq. Fl. Ind. Bat. ii. 566 = *Campanumœa celebica.*
Codonopsis cashmeriana, Royle, Illust. Bot. Him. 450 = *Campanula cashmiriana.*
Codonopsis cordata, Hassk. in Retzia, i. 9 = *Campanumœa javanica.*
Codonopsis cordifolia, Kom. in Act. Hort. Petrop. xxix. (1908) p. 108 = *Campanumœa javanica.*
Codonopsis gracilis, Hook. f. & Thoms. Illust. Him. Pl. t. 16 A = *Leptocodon gracilis.*
Codonopsis inflata, Hook. f. & Thoms. in Journ. Linn. Soc. ii. (1858) 13 = *Campanumœa inflata.*
Codonopsis javanica, Hook. f. & Thoms. Illust. Him. Pl. t. 16 B = *Campanumœa javanica.*
Codonopsis leucocarpa, Miq. Fl. Ind. Bat. ii. 565 = *Campanumœa celebica.*
Codonopsis parviflora, Wall. Cat. n. 1300 = *Campanumœa parviflora.*
Codonopsis truncata, Wall. Cat. n. 1301 = *Campanumœa celebica.*

Another Specimen of *Platanthera chlorantha* with Three Spurs.

By W. Botting Hemsley, F.R.S., F.L.S.

(With 2 Text-figures.)

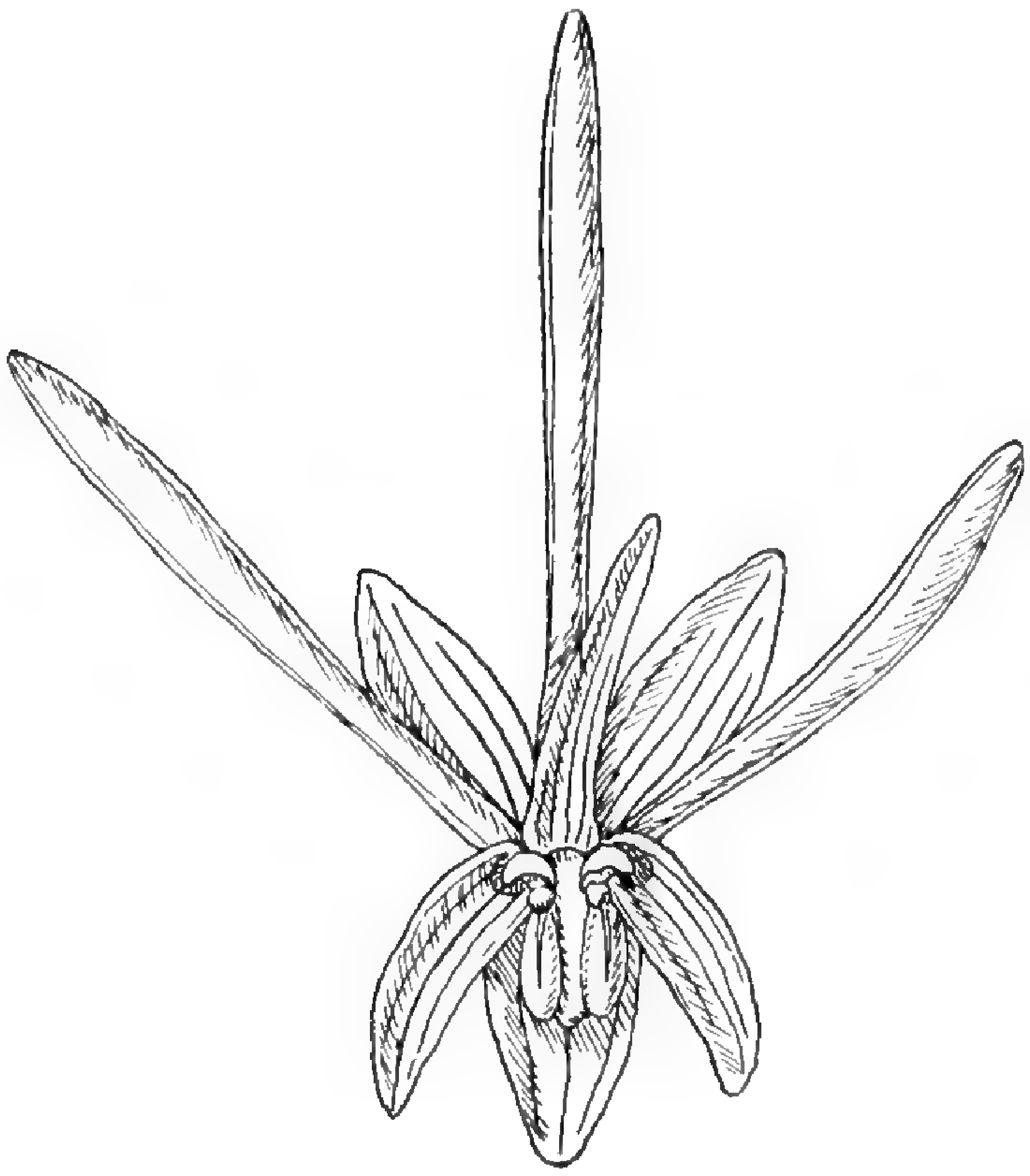
[Read 19th March, 1908.]

Early last year I exhibited and described before the Society an inflorescence of *Platanthera chlorantha* in which all the flowers were three-spurred, and the Society did me the honour of publishing my description and figures. This led to a communication from the Rev. E. A. Woodruffe-Peacock, who informed me that somewhere about the year 1902 a lady of Bath sent him a *Platanthera* to name. It turned out that this had three-spurred flowers, and he showed it round at the time, but nobody took any particular interest in it and he finally placed it in the county herbarium at Lincoln. Mr. Woodruffe-Peacock kindly offered to try to recover the specimen should I care to see it. In view of the great rarity of this kind of metamorphosis, I gladly accepted this offer, and I think the result of my examination of the specimen is of sufficient importance to bring it before the Society.

In the specimen I exhibited last year the additional spurs were developments of the lateral sepals. Now, the normal spur of an orchid flower is a basal appendage of the labellum, one of the petal series, produced below the point of its attachment ; so that was an instance of what

is termed false peloria. The specimen I now exhibit is an example of true peloria ; all the spurred organs being of the inner or petal series of the floral envelope. As in my former exhibit, all the flowers, originally eleven in number, are transformed, and the ovary is not twisted. The spurs in some of the flowers are of unequal length, and the limbs or blades are a little unequal in size and shape. In other flowers the three spurs and three blades are almost uniform in size and shape. But the flowers

Fig. 1.



Front view of a flower with unequal spurs, about twice natural size.

have not become symmetrical as to the sepals and petals, the straight spurs being directed upwards, radiating through about a quarter of a circle ; in other words their divergence is about forty-five degrees. The blades of the petals have undergone very little modification ; much less than the blades of the sepals of the other three-spur specimen to which I have referred.

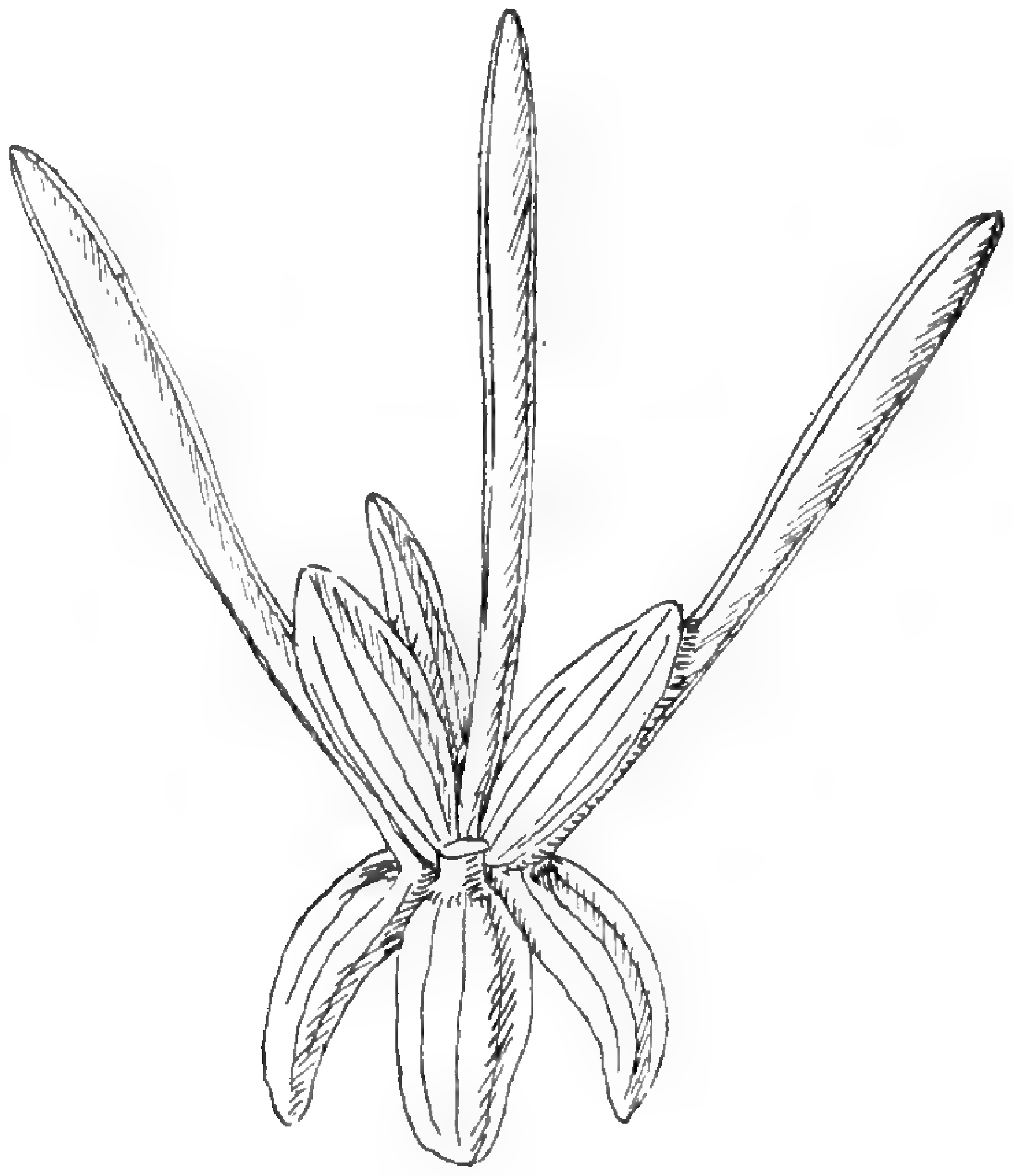
So far as my investigations go, this is the first record of what may be termed lip-peloria with spurs, and my colleague Mr. R. A. Rolfe tells me that no other instance has come under his observation. Concerning the occurrence of peloria in orchids generally, Penzig says*: "The formation of peloria is very frequent in orchids, usually occurring, however, in solitary lateral flowers, not in whole inflorescences." Concerning peloria in *Platanthera bifolia*, he says† : "several instances of peloria have been

* Pflanzen-Teratologie, vol. ii. p. 331.

† *Op cit.* p. 366.

described, mostly formed by the labellum taking the shape of the paired petals, the flower being consequently spurless. In most instances there were also three fertile stamens—the outer. Once only I observed another kind of peloria, in which the paired petals were elongated and similar to the labellum, but without spurs." Of *P. chlorantha* he records two instances of spurless peloria, but no other form of peloria. Spurless labellum peloria he also records for *Platanthera ciliaris*, *P. fimbriata*, and *P. hyperborea*.

Fig. 2.



Back view of a flower with equal spurs, about twice natural size.

The exact locality of Mr. Woodruffe-Peacock's specimen is unknown, but it was presumably taken somewhere in the neighbourhood of Bath, as it is accompanied by the following undated note :—

"Queen's Canal, Bath.

"I am sending an orchid which I thought might be of interest, each flower has three spurs instead of one. I am afraid I have kept it too long to be of much use.

(Signed) Susan Allett."

The flowers of the present specimen are somewhat smaller than those of *P. chlorantha* ; the sepals being only about 1 cm. long and the spurs 2·3 cm. long.

I have no explanation to offer as to the cause of this metamorphosis.

It may, perhaps, be regarded as a partial reversion to a regular form, but I do not think it is a deformity in the sense that an extra finger or thumb is. What one would very much like to know is whether it is permanent; whether the successive annual tubers go on producing three-spurred flowers.

Since the publication of the article on my first three-spurred *Platanthera*, and since my present note was written and in possession of the Society, Mr. S. Sommier of Florence has sent me a copy of a paper of his on *Platanthera bifolia* Reichb. *tricalcarata* (Bullettino della Società Botanica Italiana, n. 6, July 1898, p. 186), which I had unfortunately overlooked. Mr. Sommier describes an example of false peloria of exactly the same nature as my published account, namely the production of spurs by the two lateral sepals, all of the flowers being transformed.

His specimen was gathered in a wood in the neighbourhood of Florence, where normal *P. bifolia* was common, but he could not find another plant of the anomalous form.

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BOTANY

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The sixth volume, for 1906, will shortly be issued.

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THE JOURNAL

OF

THE LINNEAN SOCIETY.

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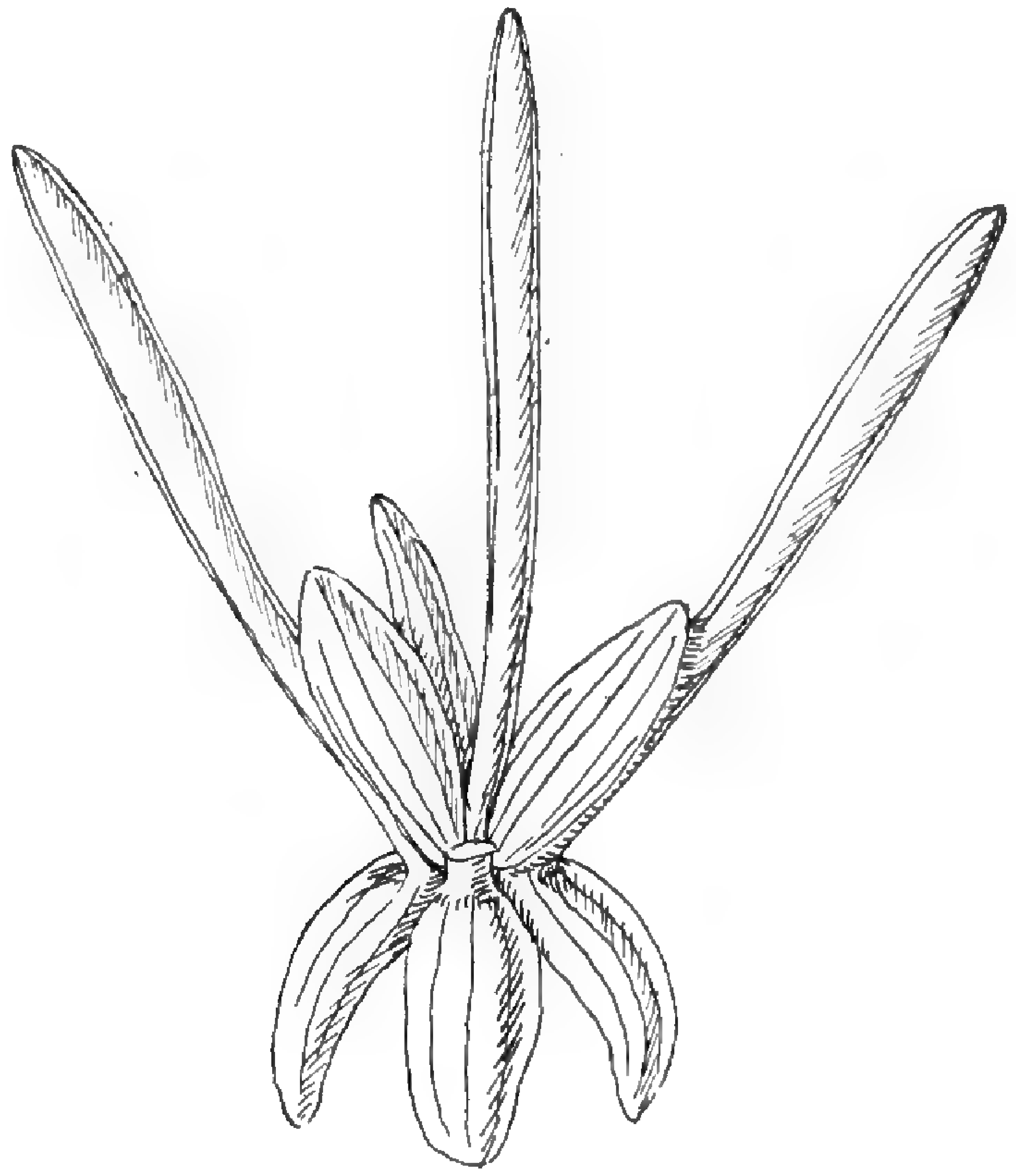
described, mostly formed by the labellum taking the shape of the paired petals, the flower being consequently spurless. In most instances there were also three fertile stamens—the outer. Once only I observed another kind of peloria, in which the paired petals were elongated and similar to the labellum, but without spurs." Of *P. chlorantha* he records two instances of spurless peloria, but no other form of peloria. Spurless labellum peloria he also records for *Platanthera ciliaris*, *P. fimbriata*, and *P. hyperborea*.

Fig. 2.



Back view of a flower with equal spurs, about twice natural size.

The exact locality of Mr. Woodruffe-Peacock's specimen is unknown, but it was presumably taken somewhere in the neighbourhood of Bath, as it is accompanied by the following undated note :—

"Queen's Canal, Bath.

"I am sending an orchid which I thought might be of interest, each flower has three spurs instead of one. I am afraid I have kept it too long to be of much use.

(Signed) SUSAN ALLETT."

The flowers of the present specimen are somewhat smaller than those of *P. chlorantha* ; the sepals being only about 1 cm. long and the spurs 2·3 cm. long.

I have no explanation to offer as to the cause of this metamorphosis.

It may, perhaps, be regarded as a partial reversion to a regular form, but I do not think it is a deformity in the sense that an extra finger or thumb is. What one would very much like to know is whether it is permanent; whether the successive annual tubers go on producing three-spurred flowers.

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The CARYOPHYLLACEÆ of Tibet. By FREDERIC N. WILLIAMS, F.L.S.

[Read 4th June, 1908.]

THE plants collected in the course of the Military Expedition to Lhassa in 1903–4, undertaken by the Indian Government, in relation to the Tibet Frontier Commission, were stored in the Calcutta Herbarium. It was the intention of Col. Prain to issue a Report, which should include an account of the plants collected on the Expedition together with other small parcels of Tibetan plants which had been sent during the previous 20 years to the Calcutta Herbarium and had lain there unexamined. On Col. Prain leaving Calcutta to take up his duties at Kew this idea was abandoned, and those who had undertaken to examine the material of different families were accorded permission to publish the results of their determinations through some other source.

Mr. W. B. Hemsley's 'Flora of Tibet' was published in April 1902, in this Journal (vol. xxxv.), and therefore included none of the material mentioned above. Mr. Hemsley therein enumerates 11 species of Caryophyllaceæ. The reason for offering the present paper for publication is that, after examination of the further material available, the number of species of Caryophyllaceæ is increased to 43. The limits of Tibet as defined by Mr. Hemsley in his 'Flora' are strictly adhered to: otherwise further additions to the Himalayan Flora would have been included, on the confines of Tibet, but politically within the area of Sikkim and Kashmir. Mr. Hemsley has elsewhere pointed out the misapplication of the name of "West Tibet" to a province of Kashmir.

LIST OF SPECIES.

Subfam. *Alsineæ.*

1. Stellaria subumbellata, *Edgew.*
2. S. gyangtsensis, sp. n.
3. S. dianthifolia, sp. n.
4. S. graminea, *Linn.*
5. S. lanata, *Hook. f.*
6. S. Cherleriæ, *Williams.*
7. S. arenaria, *Maxim.*
8. Krascheninnikowia himalaïca, *Korshinsky.*
9. Cerastium pumilum, *Curtis.*
10. Alsine Roylei, *Fenzl.*
11. Arenaria orbiculata, *Edgew.*
12. A. monosperma, sp. n.
13. A. ciliolata, *Edgew.*
14. A. Stracheyi, *Edgew.*
15. A. ramellata, sp. n.
16. Arenaria melandryiformis, sp. n.
17. A. melandryoides, *Edgew.*
18. A. acicularis, sp. n.
19. A. ischnophylla, sp. n.
20. A. monticola, *Edgew.*
21. A. kansuensis, *Maxim.*
22. A. monantha, sp. n.
23. A. polytrichoides, *Edgew.*
24. A. pulvinata, *Edgew.*
25. A. densissima, *Edgew.*
26. A. glanduligera, *Edgew.*
27. A. yunnanensis, *Franch.*
28. A. cerastiiformis, sp. n.
29. Gooringia Littledalei, *Williams.*
30. Thylacospermum rupifragum, *Schrenk.*

Subfam. *Sileninea.*

31. Silene cæspitella, sp. n.
32. S. adenocalyx, sp. n.
33. S. subcretacea, sp. n.
34. S. Moorcroftiana, *Rohrb.*
35. S. Waltoni, sp. n.
36. Hedona ischnopetala, sp. n.
37. Melandryum nigrescens, comb. n.
38. Melandryum apetalum, *Fenzl.*
39. M. indicum, *Walp.*
40. M. jugorum, sp. n.
41. M. lhassanum, sp. n.
42. M. viscidulum, comb. n.
43. Gypsophila cerastioides, *D. Don.*

1. Stellaria subumbellata, *Edgew.*

Khamba Fort, 1903 (*Col. Younghusband*, n. 268 ; *Col. Prain*, n. 1150 *). Gooring Valley, 1895, at 5030 m. (*Littledale*).

2. Stellaria gyangtsensis, sp. n. (Subg. *Eustellaria*, sect. Stellaria propria.)

Squarrosula, divaricata, viridis, glabra. Caules angulati tenues ramosi ; rami teretes foliosi superne scabride puberuli. Folia 9–11 mm., sessilia anguste linearia acuminata uninervia. Flores divaricato-cymosi ; pedicelli flore sesqui-duplo longiores. Bracteæ lanceolatæ parvæ purpureo-scariosæ. Sepala lanceolata acuminata uninervia anguste scarioso-marginata. Petala bipartita, calycem æquantia vel eo paullo longiora. Stamina distincte perigyna. Capsula obovato-globosa. Semina brunnea magna arcte seriatim papilloso-granulata subrotundo-reniformia.

Gyangtse, 1904 (*Capt. Walton*, n. 41, n. 1120).

A plant much resembling *S. uda* in the arrangement of the flowers and form of the leaves.

3. Stellaria dianthifolia, sp. n. (Subg. *Eustellaria*, sect. Stellaria propria.)

Glauco-virens, glabra vel parce puberula. Caules angulati tenues simplices, superne in dichasium soluti. Folia 10–16 mm., elongato-linearia acuminata uninervia, subtus breviter puberula, basin versus margine ciliolata. Flores in dichasium laxum terminale haud foliatum dispositi, longe pedicellati. Pedicelli 12–14 mm., basi etiam ad medium bibracteati ; bracteæ lineares acuminatæ parvæ scariosæ. Dichasium 6–9-florum. Sepala lanceolato-linearia acuminata trinervia anguste scarioso-marginata. Petala profunde bipartita, calyce breviora, lobis angustis. Stamina distincte perigyna. Capsula oblonga. Semina parva ($\frac{1}{4}$ eorum præcedentis), brunnea ruguloso-granulata compresso-subauriformia.

Tibet, without locality, 1884 (*King's collector*, n. 366).

4. Stellaria graminea, *Linn.*

Forma nana, foliis brevioribus minus acutis.

* The numbers from 1098 to 1218 are not collector's numbers, but numbers given in the Kew Herbarium.

Lungyung and Tisum, at 4570 m., 1848 (*Strachey & Winterbottom*). Khamba Fort, 1903 (*Col. Younghusband*, n. 1121).

The Tibetan plant is a high alpine dwarf form distinct in the much shorter and less pointed leaves, and in being more compact in habit.

5. STELLARIA LANATA, *Hook. f.*

Redong-Oong, near Chumbi, 1878 (*Dungboo*, n. 1131). Bang Chin, a mountain west of Chumbi, 1882 (*King's collector*, n. 1130).

6. STELLARIA CHERLERIÆ, *Williams, in Bull. Herb. Boiss.* sér. 2, vii. (1907) 830.

Central Tibet: Gooring Valley, at 5030 m. (*Littledale*, 1895).

Var. UNIFLORA, *Williams, in Bull. Herb. Boiss.* sér. 2, vii. (1907) 832.

N. Tibet (*Przewalski*, 1884). Central Tibet: Gooring Valley, at 5030 m. (*Littledale*, 1895); between camps 26–27 (*Sven Hedin*, 14 Sept. 1896), E. Tibet: Tangut (*Przewalski*, 1884). S. Tibet: Chumbi (*King's collector*, 1882, n. 1168; *C. H. Bell*, 1904, Tibet Frontier Commission, n. 1154); Phari (*Dungboo*, 1877, n. 4594).

Var. FASCICULATA, *Williams, in Bull. Herb. Boiss.* sér. 2, vii. (1907) 833.

N. Tibet (*Przewalski*, 1884): Yatung, lat. 27° 51′, long. 88° 35′ (*H. E. Hobson*, 1897). S. Tibet (*King's collector*, 1882, n. 1167): Za-ne-gang, between Chumbi Fort and Cho Pass (*King*, 1882, n. 1208); Put-lo, in the Chumbi district (*King's collector*, 1884, n. 21).

7. STELLARIA ARENARIA, *Maxim. Fl. Tangutica*, p. 91, t. 29. fig. 18 (1889).

Tangut (*Przewalski*, 1884; type-specimens in Herb. Petropolit.).

8. KRASCHENINNIKOWIA HIMALAÏCA, *Korshinsky, in Bull. Acad. Pétersb.* 1898, p. 40.

Syn.—*Stellaria Davidi*, var. *himalaïca*, Franch., Pl. Delavay. i. p. 100; *Stellaria bulbosa*, Hook. f., Fl. Brit. Ind. i. p. 231, *non* Wulf.; *Krascheninnikowia rupestris*, auct., *non* Turcz.

Tibet: on the Bhutan frontier, at Ga-leng-kya, 1882 (*King's collector*, n. 1136), and on the Pay-Goong Pass in the Chumbi district, 1884 (*King's collector*, n. 447).

Korshinsky has re-established and defined this genus on a satisfactory basis, and clearly distinguishes the 9 species which are now included in it.

9. CERASTIUM PUMILUM, *Curtis.*

Tibet, without locality, 1884 (*King's collector*, "Fl. of Thibet, n. 344"); valley around Chumbi, 1904 (*E. H. Walsh*, n. 18).

Var. ALPESTRE, *Williams*, comb. nov.

Phari, 1877 (*King*, "Fl. of Thibet Himalaya," n. 4583).

Syn.—*Cerastium glutinosum*, var. *alpestre*, Willk. & Lange, Prodr. Fl. Hisp. iii. p. 633.

The Tibetan specimens of the type agree exactly with specimens of *C. pumilum* in Herb. Kew. from both N. Persia and Yunnan.

The Phari plant agrees exactly with Willkomm's *Pl. Hisp. exs.* 1850, n. 298,—"pumilum, densissime pubescens valdeque viscosum, cymis condensatis, floribus breviter pedicellatis." This is Willkomm's Latin translation of the original description in Loscos & Pardo's "Series imperfecta de las Plantas Aragonesas espontaneas, particularmente de las que habitan en la parte meridional," p. 19 (1862).

10. ALSINE ROYLEI, *Fenzl* ex Hook. f., Fl. Brit. Ind. i. p. 236.
Phari, 1879 (*Dungboo*, n. 1144).

11. ARENARIA ORBICULATA, *Edgew.*
Do-ree-Chu, in the Chumbi district, 1884 (*King's collector*, n. 555).

12. ARENARIA MONOSPERMA, sp. n. (Subg. *Euarenaria*, sect. Euthaliæ.)

Perennis, foliosa, cæspitosa, humilis, 10–13 cm. Caules teretes tenelli geniculati ramosi, inferne purpurascentes, ramis et geniculis interdum scabridis, ceterum glabri. Folia plerumque 9–10 mm., linearia acuminata uninervia patentia subsquarrosa, juniora nitescentia. Flores axillares solitarii, et terminales cymosi, ramulis cymuliferis laxe dichasiiformibus; pedicelli flore longiores. Calyx 4 mm., basi haud truncatus; sepala lanceolata acuminata uninervia papilloso-punctata, margine lævia paullo incrassata haud scariosa. Petala alba obovato-linearia, calyce breviora. Ovula pauca. Capsula valvis 6 dehiscens, monosperma. Semen solitarium magnum auriformi-globosum fulvo-brunneum undique granulato-tuberculatum.

Closely allied to *A. tenella*, Duthie. Each fully matured fruit contains a single large seed almost completely filling the capsule.

Tibet, without locality, 1882 (*King's collector*, n. 1119).

13. ARENARIA CILIOLATA, *Edgew.*
Chumbi district, 1884 (*King's collector*); at Pun-ka-bee-see-mo (*King's collector*, "Fl. of Chumbi," n. 25), at Ka-poop (*King's collector*, "Fl. of Chumbi," n. 142); Tibet frontier, 1904 (*C. H. Bell*).

14. ARENARIA STRACHEYI, *Edgew.*
Chumbi district: Pan-Thung-lo, 1879 (*Dungboo*, n. 1137), Tab Trong, 1879 (*Dungboo*, n. 1148), Sy-am-poo, 1884 (*King's collector*, n. 130), and without locality, 1884 (*King's collector*, "Fl. of Thibet," n. 315). Rakas Tal, 1848, at 4730 m. (*Strachey & Winterbottom*). W. Tibet: on broken granite, 1896, at 5125 m. (*Deasy & Pike*, n. 876).

What is intended by the "*Arenaria Stracheyi*" of the Fl. of British India

is somewhat obscure. The material (fragmentary scraps on a single sheet) is so scrappy that the vague description given by no means identifies the "type-specimens." The description seems to indicate a plant quite glabrous, with short stems and solitary flowers, and leaves thickened though not exactly fleshy, and narrower in proportion than those of other species in the section *Sikkimenses*; and more resembling the Persian *A. bulica* rather than any Himalayan species. It is certainly doubtful whether the specimens here referred to *A. Stracheyi* really belong to this species, but they resemble the plant more than they do any of the other specimens of *Arenaria* in the Kew Herbarium; and *A. Stracheyi* is recorded for Tibet.

15. Arenaria ramellata, sp. n. (Subg. *Euarenaria*, sect. Sikkimenses.)

Nana, glabra. Caules 4–6 cm., divaricato-adscendentes ramosi, ramis divergentibus, foliosi. Folia 8–9 mm., usque ad flores numerosa, lanceolata acuta sessilia firma plana, nervis obscuris, basin versus attenuata, et ibidem interdum margine ciliata, ceterum glabra; folia pedicellaria haud bracteiformia sed aliis consimilia. Flores ad ramos laxe cymosos solitarii, pedicellis longiores. Calyx campanulatus, basi attenuatus; sepala lanceolata acuminata, apice recurva, anguste membranaceo-marginata. Petala alba obovata, calyce sesquilongiora, apice rotundata, basi vix unguiculata.

Karoo-la, 15 miles from Lhassa, 1878 (*Dungboo*, n. 1158).

Very near *A. Stracheyi*, but differing both from the type-specimens and also from Edgeworth's description. Readily distinguished from the next species, to which it is closely allied.

16. Arenaria melandryiformis, sp. n. (Ejusdem sect.)

A specie sequente diversa: caules altiores, 10–15 cm., magis foliati. Folia basalia spathulato-linearia sæpe fasciculata, caulina lanceolata acuta. Sepala anguste lanceolata, vix obtusa, obscure trinervia. Petala obovata, calyce duplo longiora.

a. Forma glanduloso-pubescens.

Beong-chin, a mountain west of Chumbi in Tibet Himalaya, 1882 (*King's collector*, n. 1127).

b. Forma magis hirsuta.

Syam-poo, in Chumbi district, Tibet Himalaya, 1884 (*King's collector*, n. 123).

17. Arenaria melandryoides, *Edgew.*

Syam-poo, in Chumbi district, 1884 (*King's collector*, n. 129); Rungkia, in Chumbi district, 1879 (*Dungboo*, n. 1122); Naku Pass, 1903 (*Col. Younghusband*, n. 169).

These agree with specimens in Herb. Kew. from Yatung in Tibet (*H. E. Hobson*, 1897), overlooked in Mr. Hemsley's 'Flora' (p. 170).

18. Arenaria acicularis, sp. n. (Subg. *Eremogoneastrum*, sect. i.)

Radix prælonga crassa lignosa. Caudex lignosus polycephalus. Caules 65 mm., simplices, scabre pubescentes. Folia lineari-acicularia, trinervia, lateralibus marginantibus ; floralia lanceolato-linearia pungentia, margine scariosa, basi late scarioso-vaginantia. Flores in dichasium fasiculato-glomeratum 6–9-florum dispositi, pedicellis glanduloso-pilosis suffulti. Calyx basi rotundatus, haud incrassatus ; sepala lanceolata acuminata tenuiter trinervia, nervis approximatis, late scarioso-marginata, apice recta, parte scariosa sæpius purpureo-incarnata. Petala obovata, calyce sesqui-duplo longiora. Capsula obovato-oblonga.

Flowers much smaller than in *A. festucoides*, and more crowded at the top of the flowering stem ; leaves longer and narrower, never falcate. Somewhat like *A. Przewalskii*, but the leaves in the latter are rough-edged, those of the shoots are obtuse, the cyme is three-flowered, and the disk-glands 5 (not 10).

Kannali River, 1848, at 4730 m. (*Strachey & Winterbottom*, "*A. festucoides*," non *Benth.*). Tibet, without locality ("Fl. of Thibet," n. 66, 1882, and n. 286, 1884, *King's collector*) ; Khamba Fort, 1903 (*Col. Prain*, n. 1209) ; Gyangtse, 1904 (*Capt. Walton*, n. 95, n. 1116) ; Phembu Pass, 10–15 miles north of Lhassa, and Yam Doh Cho, 1904 (*Capt. Walton*, n. 1117, n. 1118) ; Lhassa, at 3600 metres, 1904 (*Col. Waddell*).

19. Arenaria ischnophylla, sp. n. (Ejusdem sect.)

Dense arcteque cæspitosa. Caudex lignosus polycephalus ; rami dense foliati. Folia 7–9 mm. vel paullo longiora, subtriquetra rigida pungentia uninervia, basi scarioso-vaginantia, margine incrassata. Flores pauci, breviter pedicellati, pedicellis pilosis. Calyx basi truncatus ; sepala 4 mm. long., lanceolata acuminata, apice recta, trinervia, nervis lateralibus tenuioribus, ultra nervos late scariosa. Petala 5 mm. longa, alba ovato-elliptica, calycem paullum excedentia, basi obsolete unguiculata, apice rotundata. Ovarium globosum.

Near *A. kansuensis*, in which the mass of flowers almost conceals the dense short leaves, whereas in *A. ischnophylla* the dense longer leaves conceal the few flowers.

Khamba Fort, 1903 (*Col. Younghusband*, n. 107).

20. Arenaria monticola, *Edgew.*

Phari (*Dungboo*, 1877, n. 4559, 1879, n. 1146) ; Syam-poo, in Chumbi district (*King's collector*, 1884, n. 112, n. 1164).

21. Arenaria kansuensis, *Maxim.*

Karoo Pass, 15 miles from Lhassa, at 5000 m. (*Dungboo*, 1878, n. 1152 ;

Capt. Walton, 1904, n. 1149); Tibet, without locality (*King's collector,* 1882, n. 1164 bis), and Pem Pass, near Chum-la-ri (*King's collector,* 1882, n. 1145).

22. ARENARIA MONANTHA, sp. n. (Subg. *Eremogoneastrum,* sect. ii.)

Nana, uniflora, stricta, 5–6 cm. Caulis inferne bifariam pubescens, superne breviter et retrorsum pilosus, simplex. Folia 8 mm., elliptico-linearia acuta subenervia, supra glabra, subtus puberula, margine parce ciliolata. Flos longe pedunculatus; pedunculus basi sæpe foliis 4 approximatis instructus. Calyx basi truncatus, aperte campanulatus; sepala ima basi connata, pilosa elliptica vix acuta, alternatim anguste lateque scarioso-marginata, obscure nervata. Petala integra ovata alba, basi breviter unguiculata, longitudinaliter evidenter striata, calyce sesqui-duplo longiora. Glandulæ luteo-virentes prominentes, staminibus alternantes.

Not unlike a dwarf and depauperate form of *A. Griffithii,* but leaves not rigid. There is already an "*Arenaria uniflora*" from the island of Kurre-Saar in the Gulf of Riga, though, indeed, it is a doubtful species. Otherwise this name would have been adopted for the present species, in accordance with the Latin form of the generic name.

Hills above Lhassa, Aug. 1204 (*Capt. Walton,* n. 1138).

23. ARENARIA POLYTRICHOIDES, *Edgew.*

Za-na-gang, 1879, Tibet, 1882, n. 112, Mee-rook Pass, in Chumbi district, 1884, n. 338 (all *King's collector*).

Var. PERLEVIS, *Williams.*

Rungkia, in Chumbi district, 1879 (*Dungboo,* n. 1151); Tibet, without locality, 1884 (*King's collector,* n. 237); Khamba Fort, n. 53, between Kangra Lama Pass and Khamba Fort, at 4650 to 5100 m., n. 1163, Giagong, at 4500 m., n. 1161 (all of *Col. Younghusband,* 1903); Phari plain and the Upper Chumbi Valley on the way to Phari, 1904 (*E. H. Walsh,* n. 152), Balch Pass, 1848 (*Strachey & Winterbottom*); Gooring Valley, 1895 (*Littledale*). N. Tibet (*Wellby & Malcolm*; *Sven Hedin*). South shore of Lake Mangtza Cho (*Deasy & Pike,* n. 813).

24. ARENARIA PULVINATA, *Edgew.*

Tibet, 1882 (*King's collector,* n. 112, n. 131).

25. ARENARIA DENSISSIMA, *Edgew.*

Tibet, 1882 (*King's collector,* n. 1165).

26. ARENARIA GLANDULIGERA, *Edgew.*

Chumbi district, 1878 (*Dungboo,* n. 1201); Ze-lep-la, n. 1202, Kang-boo, one day north of Phari, n. 1203, Gup-ten-de-la, a little above Chumbi, n. 1155, without locality, n. 1166, n. 1204, n. 1205 (all of *King's collector,* 1882);

Pun-ka-bee-see-mo, 1884 (*King's collector*, "Fl. of Chumbi," n. 24); Khamba Fort, 1903 (*Col. Prain*, n. 1162, n. 1169, n. 1206); Naku Pass, n. 235 (*Col. Younghusband*, 1903).

Var. MICRANTHA, *Williams.*

Folia elliptico-oblonga. Flores minores quam in typo. Sepala obtusa, margine distincte scariosa, vix glandulosa.

With somewhat the facies of *A. ciliolata.*

Mee-rik Pass, 1884 (*King's collector*, n. 628).

Var. CERNUA, *Williams.*

Folia elliptica acuta, in caule pauciora. Flores majores quam in typo, in pedicellis tenuioribus suffulti. Sepala paullum latiora, angustius scarioso-marginata, minus glandulosa.

Bears the same relation to the type as does *A. ciliolata* var. *pendula*, Duthie, to the type of this species.

Tibet, without locality, 1884 (*King's collector*, n. 333); Naku Pass, 1903 (*Col. Younghusband*, n. 172).

27. ARENARIA YUNNANENSIS, *Franch., in Bull. Soc. Bot. France*, xxxiii. (1886) p. 431.

Bue-tang, 18 miles north-west of Chumbi, n. 1133 (*Dungboo*, 1878); Shand-hu near Phari, n. 1129, and Chumbi district, n. 1134 (*King's collector*, 1882).

These specimens exactly agree with Franchet's authentic specimens in Herb. Kew.

Forma *angustifolia*.—Folia inferiora breviter petiolata anguste lanceolata, superiora sessilia oblonga.

Do-tho in Chumbi district, n. 1128 (*Dungboo*, 1879).

28. ARENARIA CERASTIIFORMIS, sp. n. (Subg. *Macrogyne*.)

Nana, perennis, 7–8 cm. Radix longa. Caules basi ramosi, ramis foliosis unifloris teretibus, bifariam scabro-puberulis. Folia 8–10 mm., crassiuscula elliptica uninervia, nervo modice prominente, basi laxe connata, margine scabro-puberula. Sepala basi saccata, lanceolato-linearia hispidula vix acuta, haud scarioso-marginata, margine glanduloso-ciliolata. Petala 1 cm., alba (vel pallide rosea in specim. nonnullis), calyce duplo longiora, e basi cuneatâ distincte unguiculatâ oblongâ. Filamenta subulata ciliolata. Styli 2.

An *Arenaria* with the facies of *Cerastium*, closely allied to *A. longistyla*, Franch., and, like it, found at high altitudes.

Phari, 1877 (*King*, n. 4588, *Dungboo*, n. 4588 bis), 1879 (*Dungboo*, n. 1147); Mee-rik Pass, Chumbi district, 1884 (*King's collector*, n. 1207); Giagong, 1903, at 4500 m. (*Col. Younghusband*, n. 1160).

29. Gooringia Littledalei, *Williams, in Bull. Herb. Boiss.* sér. 2, vii. (1897) 530.

Gooring Valley, 1895, at 5030 m. (*Littledale* ;=A. Littledalei, *Hemsley*).

30. Thylacospermum rupifragum, *Schrenk.*

Goching, n. 2, and Khamba Fort, at 5700 m. (*Col. Younghusband*, 1903) ; Guge, 1848, from 4570 to 5120 m. (*Strachey & Winterbottom*). W. Tibet, 1896, at 5218 m. (*Wellby & Malcolm*).

31. Silene cæspitella, sp. n. (Subg. *Eusilene*, sect. Cincinnosilene.)

Perennis, cæspitosa, basi fruticulosa. Radix lignosa. Caules florigeri ex rosula foliorum media editi, erecti, pubescentes, 13–25 cm. Folia 4–7 cm., elongato-linearia rosulata acuminata trinervia, basi membranaceo-vaginantia, margine pubescentia. Bracteæ et prophylla minora uninervia, ceterum autem foliis conformia. Flores in cincinnos simplices dispositi. Calyx evenius clavatus, fructifer paullum ampliatus basi rotundatus, crispato-pubescens, striis furcatis superne bifurcatim conjunctis, dentibus ovatis obtusis late scarioso-marginatis. Petala alba, unguibus inclusis superne utrinque auriculato-dilatatis, lamina anguste oblonga, lobis oblongis, appendicibus binis ovatis obtusis. Genitalia inclusa. Capsula oblonga, fere sessilis. Semina auriformia, dorso canaliculata obtuse tuberculata, faciebus concava striata.

Somewhat resembles in facies *S. tenuis*, but differs in many important characters, the cincinnate sequence of the flowers being quite evident.

Phee-mong, a mile from Chumbi, 1878 (*Dungboo*, n. 1110), Chumbi, 1879 (*Dungboo*, n. 1111), Chumbi, 1882 (*King's collector*, n. 1210) ; Tibet, without locality, 1882 (*King's collector*, n. 164, n. 1115) ; Lomok, 1903 (*Col. Younghusband*, n. 213) ; Gyangtse, 1904 (*Capt. Walton*, n. 118, n. 1114, n. 1108,—left-hand specimen on sheet). Note n. 1108 under 33.

32. Silene adenocalyx, sp. n. (Subg. *Eusilene*, sect. Dichasiosilene.)

Caulis adscendens, breviter scabreque pubescens, ramosus, ramis foliosis. Folia caulina late lanceolata, ramealia angustius lanceolata, omnia acuminata uninervia breviter scabreque sparsim pubescentia, nervo subtus longius piloso, margine glanduloso-ciliata. Flores laxi, breviter pedicellati in dichasiis paucis axillaribus et terminalibus, dichasio 3- vel sæpe 5–7-floro. Calyx tubulosus scaber, basi truncatus, pilis glandulosis brevibus dense vestitus, evenius, striis tenuibus viridibus a glandulis fere occultatis ; dentes longe lanceolati acuminati vix acuti, margine obscure scariosi. Petala alba, lamina parva biloba, ungue exauriculato valde exserto, lobis oblongis, appendicibus binis, lamina $\frac{1}{4}$–$\frac{1}{5}$ unguis æquante. Capsula oblonga, carpophorum glabrum æquans.

Khamba Pass, at 1440 m., 1904 (*Capt. Walton*, n. 1104).

So named from the structure of the calyx. Both this and the next species belong to that group of the *Macranthæ* series which includes *S. cretacea*. This plant is, however, a difficult species to study and compare. Rohrbach's description (Monogr. n. 107, p. 135) is brief and somewhat vague : and there are only two sheets of *S. cretacea* in Herb. Kew., including 5 specimens,—(1) and (2) from the Astrakhan Desert, (3) and (4) from chalky hills above the river Don, and (5) from S. Russia.

33. Silene subcretacea, sp. n. (Ejusdem sect.)

Caulis fruticulosus erectus, breviter canescenti-pilosus, 1–3-florus, 4 dem. Folia 7 mm., brevia linearia acuta uninervia, breviter canescenti-pilosa. Flores solitarii vel remoti, breviter pedicellati. Calyx 18 mm., tubuloso-clavatus pilosulus, basi truncatus, evenius, striis tenuibus, fructifer superne ampliatus ; dentes oblongo-lanceolati acuti albo-marginati. Petala alba ecoronata, ungue exauriculato exserto. Capsula oblonga, carpophoro glabro sesquilongior. Semina papillosa, dorso sulcato-excavata, faciebus concava.

Khamba Fort, 1903 (*Col. Younghusband*, n. 73,—flower-specimens) ; Gyangtse, 1904 (*Capt. Walton*, n. 105, n. 1108,—fruit-specimens).

34. Silene Moorcroftiana, *Rohrb. Monogr. Gatt. Silene*, p. 129, n. 93 (1868), forma nana, *Hook. f. Fl. Brit. Ind.* i. 219 (1874).

Near Rakas Tal, 1848, from 4570 to 5180 m. (*Strachey & Winterbottom*).

35. Silene Waltoni, sp. n. (Subg. *Eusilene*, sect. Botryosilene).

Caulis erectus robustus rotundatus rubens basi fruticulosus, alternatim ramosus, ramis divergentibus laxe racemosis, breviter parceque pilosus. Rami floriferi primum racemosi, ramulis secundariis dichasia subcomposita gerentibus. Folia 9 mm., læte virentia late linearia vix acuta uninervia crassiuscula, subtus præsertim ad nervum pilosula, margine hispidulo-ciliata. Dichasia secundaria longe pedunculata, floribus erectis ; flos centralis breviter pedicellatus, pedicello longior ; bracteæ foliis consimiles. Calyx clavatus evenius umbilicatus tenuiter pilosulus, dentibus triangularibus obtusis late albo-marginatis dense ciliatis. Petala alba, ad faucem biappendiculata, unguibus glabris auriculatis distincte exsertis, lamina biloba, lobis latis. Filamenta glabra. Styli filiformes.

Gyangtse, 1904 (*Capt. Walton*, n. 1105).

Named after Capt. Walton, of whose assiduity in collecting Col. Younghusband speaks in such glowing terms.

36. HEDONA ISCHNOPETALA, sp. n.

Radix longa tenuis. Caulis erectus sat ramosus, cum foliis pilis brevibus reversis vestitus. Folia firma uninervia lanceolata, inferiora latiora sed basin versus attenuata, floralia lanceolato-linearia. Flores longe pedicellati, in dichasium laxum (triflorum) dispositi; pedicelli alares centrali breviores, basi prophyllis sæpe 4 approximatis instructi. Calyx pilis crustaceis brevibus crispatis dense vestitus, dentibus triangularibus vix acutis margine membranaceo-ciliatis, nervis infra dentium sinus arcuatim conjunctis. Petala anguste cuneato-obovata irregulariter erosa, ungue solum basi ciliato. Capsula sessilis. Semina atro-cyanea rotundato-reniformia, dorso faciebusque tuberculata.

Near *Hedona Davidi*, Williams, a Sze-chuen plant.

Tibet: Gum-lo-teen, in the Chumbi district, at 600 m., 1878 (*Dungboo*, n. 1106). Sikkim: Lachen, near the Tibetan frontier, at 2700 m., 1885 (*King's collector*, n. 1211).

37. MELANDRYUM NIGRESCENS, *Williams.* (Sect. Gastrolychnis.)

Syn.—*Lychnis nigrescens*, Edgew., in Hook. f., Fl. Brit. Ind. i. p. 223 (1874); *Melandryum macrorhizum*, Rohrb., in Linnæa, xxxvi. (1869) p. 228, non Walp., Rep. Bot. i. p. 280 (1842), nec *Lychnis macrorhiza*, Royle, Illustr. Bot. Himal. p. 80 (1833).

Phari, 1877 (*Dungboo*, n. 4565), Do-tho in Chumbi district, 1879 (*Dungboo*, n. 1215), and Khamba Fort, 1903 (*Col. Younghusband*, n. 275). Lanjar, 1848 (*Strachey & Winterbottom*).

38. MELANDRYUM APETALUM, *Fenzl.* (Sect. Gastrolychnis.)

Syn.—*Lychnis apetala*, Linn.

Guge, 1848 (*Strachey & Winterbottom*). W. Tibet, 1896 (*Deasy & Pike*, n. 894). Karoo Pass, 15 miles from Lhassa, at 4950 m. (*Dungboo*, 1878, n. 1101; *Capt. Walton*, 1904, n. 1100); To-koo Pass in Chumbi district (*Dungboo*, 1879, n. 1103); Tem Pass, one day north-east of Phari (*King's collector*, 1882, n. 1216); Ka-po-po (*King's collector*, 1884, n. 1217); Lomok on the Naku Pass (*Col. Younghusband*, 1903, n. 163); Naku Pass (*Col. Younghusband*, 1903, n. 165); Khamba Fort (*Col. Prain*, 1903, n. 1102), Gooring Valley, at 5030 m. (*Littledale*).

39. MELANDRYUM INDICUM, *Walp.* (Sect. Gastrolychnis.)

Pad-lo, near Chumbi, 1878 (*Dungboo*, n. 1125); Rinchin-gong, in the Chumbi Valley, 1877 (*Dungboo*, n. 4286, and *Sir G. King*, n. 4287); Chumbi district, Lo-Beang near Chumbi, and between Chumbi and the Tangka Pass, 1882 (*King's collector*, n. 1107, n. 1218, n. 1123).

40. Melandryum jugorum, sp. n. (Sect. Elisanthe.)

Perennis. Caulis e medio foliorum basalium editus, elatus ramosus, molliter pilosulus, ramis numerosis foliosis magis pilosis. Folia 10 mm., flavo-virentia villoso-pilosula uninervia elliptico-lanceolata apice falcato-acuminata. Flores in dichasiis, mediani fructiferi retroflexi. Pedunculus centralis flore multum brevior, pedunculi alares eo duplo longiores vel ultra; bracteæ foliaceæ, foliis minores, ceterum subsimiles. Calyx 10-nervius evenius oblongo-clavatus subampliatus pilosulus; fructifer 14 mm., magis distentus, infra capsulam constrictus, apice apertus, dentibus ovatis obtusis rotundatis. Petala purpureo-rubescentia, ungue glabro exserto, appendicibus conspicuis ovatis acutis. Filamenta glabra. Capsula primum medianicide dehiscens, dentibus deinde breviter bifidis, oblongo-ovata, carpophoro serius multum incrassato duplo longior. Semina reniformia, dorso faciebusque undique tuberculata, dorso leviter sulcata.

Gum-bo-teen, 800 m. above Chumbi, n. 1143 (*Dungboo*, 1878); Lo-Beang, near Chumbi, n. 1219, and Chumbi district, n. 1098 (*King's collector*, 1882).

41. Melandryum lhassanum, sp. n. (Sect. Elisanthe.)

Perennis. Caulis e medio foliorum basalium editus, tereti-rotundatus elatus erectus ramosus, pilis brevibus scabris retrorsis dense vestitus, in parte purpureo-rubescens, ramis 10–22 cm. Folia læte virentia lanceolato-ovata acuta, apicem versus haud falcato-acutata, pilis brevibus scabris retrorsis dense vestita, margine undulata ciliolata, basi connata haud attenuata; inferiora 32–36 mm., basi triplinervia, nervo mediano valido, nervis lateralibus incompletis, superiora 25–30 mm., uninervia, nervo prominente. Rami floriferi axillares et terminales. Flores in dichasiis laxe compositis. Pedunculus centralis flori æquilongus; ramuli alares longe pedunculati, pedunculis pedicellisque dense glanduloso-pilosis; bracteæ foliaceæ glanduloso-pilosæ, foliis subsimiles. Calyx 10-nervius evenius, striis purpureis, clavatus, basi truncatus, pilis glandulosis asperulato-scabridus; fructifer 12 mm., obconico-clavatus accretus, basi truncato-umbilicatus, apice apertus, infra capsulam vix constrictus, dentibus triangularibus obtusis late membranaceo-marginatis ibique nervis latius expansis. Petala rubella, calyce sesquilongiora, ungue glabro utrinque laminam versus conspicue auriculato, lamina biloba, lobis oblongis obtusis, appendicibus oblongo-linearibus obtusis vix rotundatis. Filamenta glabra. Capsula primum medianicide dehiscens, dentibus deinde breviter bifidis, oblongo-ovata, carpophorum sat crassum æquans vel eo paullum longior. Semina reniformia (immatura), dorso canaliculata cristato-tuberculata, faciebus excavato-concaviuscula vel depressa.

Quite distinct from any other species of *Melandryum*; resembling one or more of the Yunnan species described by Franchet under *Silene*.

Hills above the city of Lhassa, 1904 (*Capt. Walton*, n. 1112).

42. Melandryum viscidulum, *Williams.* (Sect. Elisanthe.)

Syn.—*Silene viscidula,* Franch., Pl. Yunnanenses, in Bull. Soc. Bot. France, xxxiii. (1886) p. 421.

A plant of the habit of *M. Olgæ,* as may be seen by comparing this Himalayan plant with specimens from the Chinese province of Manchuria in Herb. Kew. It tallies with the description of *S. viscidula,* Franch., of which there is no specimen in Herb. Kew. *M. Olgæ,* Maxim. (= *S. Olgæ,* Rohrb.), is not to be confused with *S. Olgæ,* Regel & Schmalh., a quite different plant from Russian Turkestan.

Lo-Beang, near Chumbi, 1882 (*King's collector,* n. 1109), in the same locality where *M. jugorum* occurs.

43. Gypsophila cerastioides, *D. Don.*

Chumbi Valley, 1879 (*Dungboo,* n. 1132); Gup-ten-de-la, a little above Chumbi, Aug. 1882 (*King's collector,* n. 1220,—a poor and stunted specimen); Ta-che-Kung, Mee-rook Pass, and Ha-toom-py-ong, all in the Chumbi district, 1884 (*King's collector,* n. 10, n. 345, n. 499); Chumbi Valley, 1904 (*E. H. Walsh,* n. 44).

A Contribution to the Mycology of South Africa. By W. N. Cheesman, F.L.S. With a Note on the Coprophilous Fungi, by Thomas Gibbs.

(Plate 36.)

[Read 4th June, 1908.]

The time of the visit to South Africa by the British Association during the autumn of 1905 was very enjoyable from the traveller's point of view, but not the most profitable from a botanical standpoint. In Central Africa the seasons are simply two—the wet and the dry. The rainy season or summer extends from October to April, and the dry season or winter (during which scarcely any rain falls) from May to September. It was at the end of the latter period when the visit was made, and the dry and parched appearance of the vegetation contrasted very strongly with the hearty welcome and cordial hospitality extended by the colonists to their guests. In winter the thermometer would register 90° F. at mid-day, falling to 40° at night.

Notes on Distribution.

The present contribution adds 25 species to the Mycologic flora of Africa, one of which is new to science.

This addition tends to prove what has for some time been suspected, that the numerous large and typical genera are cosmopolitan, with specialized forms—so-called species—characteristic of each region.

Among such may be enumerated *Poria vaporaria*, *Polyporus elegans*, *Schizophyllum commune*, and *Polystictus sanguineus*. Some of these, like the last-named, are most abundant in tropical regions, with but few outliers in temperate regions. Others, as *Poria vaporaria* and *Polyporus gilvus*, have their headquarters in temperate regions. An examination of the list reveals the fact that various species more or less common in the New World, Europe, and Australasia respectively are now added to the African list.

Excluding the Myxogastres, it will be observed that of the 30 species of the larger fungi 10 are cosmopolitan, whilst the remaining 20 are here recorded for the first time from the African continent; and again, 12 of the 30 are found in Australasia, two, viz. *Polyporus nanus* and *Hexagonia decipiens*, being hitherto recorded only from that quarter of the globe. This fact may be another indication of the supposed ancient land-connection

between South Africa and Australasia, a theory which is suggested so strongly in many of the Phanerogams of South Africa *.

The writer wishes to acknowledge his indebtedness to Mr. Geo. Massee for determining many of the species, and for his kind help and suggestions.

List of Fungi collected at the Victoria Falls and other places in South Africa in August and September 1905.

GASTROMYCETÆ.

NIDULARIACEÆ.

CYATHUS STERCOREUS, *De Toni.*
Victoria Falls: Livingstone Island.
Distrib. America, Australasia.

LYCOPERDACEÆ.

GEASTER LIMBATUS, *Fr.*
Victoria Falls: Palm Kloof.
Distrib. Europe, Africa, America.

LYCOPERDON LILACINUM, *Berk.*
Victoria Falls: edge of Rain Forest.
Distrib. Asia, Africa, America, Australasia.

HYMENOMYCETÆ.

AGARICACEÆ.

LEPIOTA sp.
Matoppo Hills, shaded place on the edge of a stream.

COLLYBIA sp.
Groot Schuur near Cape Town.

MYCENA sp.
Groot Schuur near Cape Town.

VOLVARIA sp.
Victoria Falls: East Ferry, on a fallen branch of a Baobab-tree.

* The Natal Coal-bearing rocks of Permo-Carboniferous age produce some six or eight species of the fossil plant *Glossopteris*, which are also abundant in the Coal-beds of the same age in Australia.

SCHIZOPHYLLUM COMMUNE, *Fr.*
On mine-props, 2000 feet deep, in Langlaagte Gold Mine, Johannesburg, and in the deep workings of the Wesselton Diamond Mine, Kimberley.
Distrib. Cosmopolitan.

POLYPORACEÆ.

TRAMETES HYDNOIDES, *Sw.*
Victoria Falls: thickly imbricate, on a fallen *Ficus*-log, East Ferry.
Distrib. Africa, America.

PORIA CITRINA, *Massee.*
Victoria Falls: Rain Forest.
Distrib. Asia.

PORIA VAPORARIA, *Fr.*
Groot Schuur near Cape Town.
Distrib. Cosmopolitan.

POLYSTICTUS SANGUINEUS, *Fr.*
Victoria Falls: Palm Kloof and Rain Forest.
Distrib. Asia, Africa, America, Australia.

FOMES SENEX, *Nees.*
On Livingstone Island fine specimens occurred on several fallen logs and also on the dead trunk of the tree bearing the initials of David Livingstone, which is now fenced round.
Distrib. Asia, America.

FOMES HEMILEUCUS, *Berk.*
Victoria Falls, near Leaping Cascade.
Distrib. America.

POLYPORUS NANUS, *Massee.*
Victoria Falls: Rain Forest.
Distrib. Australasia.

POLYPORUS ELEGANS, *Fr.*
Victoria Falls; Matoppo Hills; Cape Town.
Distrib. Europe, America, Australasia.

POLYPORUS GILVUS, *Schwein.*
Victoria Falls: Rain Forest.
Distrib. Europe, America.

POLYPORUS CRISTATUS, *Fr.*
Victoria Falls ; Park Town, Johannesburg.
Distrib. Europe, America.

POLYPORUS OCHROLEUCUS, *Fr.*
Matoppo Hills.
Distrib. Asia, Australasia.

POLYPORUS ECKLONI, *Henn.*
Victoria Falls : Rain Forest.
Distrib. Africa.

POLYPORUS VARIUS, *Fr.*
Victoria Falls : Rain Forest.
Distrib. Europe, Asia, America.

HEXAGONIA DECIPIENS, *Berk.*
Victoria Falls : on fallen branches, on the edge of the Rain Forest.
Distrib. Australasia.

HEXAGONIA POLYGRAMMA, *Fr.*
Victoria Falls : on a fallen tree, near East Ferry.
Distrib. Asia, Africa, America.

STROBILOMYCES STROBILACEUS, *Berk.*
Victoria Falls : edge of Rain Forest.
Distrib. Europe, America.

THELEPHORACEÆ.

STEREUM LOBATUM, *Fr.*
Groot Schuur near Cape Town ; East London.
Distrib. Asia, Africa, America, Australasia.

HYMENOCHÆTE TABACINA, *Lév.*
Groot Schuur near Cape Town.
Distrib. Cosmopolitan.

HYMENOCHÆTE TENUISSIMA, *Berk.*
Victoria Falls : Livingstone Island.
Distrib. Asia, America, Australasia.

CYPHELLA CHEESMANI, *Massee,* sp. nov.
Victoria Falls : Rain Forest.

Membranacea, sessilis, cupularis, demum explanata, extus villosa, nivea, 1 mm. diam.; hymenio leniter plicato. Basidia clavata, apice 4-sterigmatica ; sporis ovoideis, tenuiter asperulis, hyalinis, 12–15 × 7–8 μ.

Hab. in ramis decorticatis.

TREMELLACEÆ.

HIRNEOLA AURIFORMIS, *Fr.*
Victoria Falls: north bank of the Zambesi River.
Distrib. America, Australasia.

GUEPINIA FLABELLATA, *Fr.*
Victoria Falls: west side near Leaping Cascade.
Distrib. Asia.

CALOCERA CORNEA, *Fr.*
Victoria Falls: Rain Forest.
Distrib. Europe, America, Australasia.

PYRENOMYCETÆ.

HYPOXYLON COLLICULOSUM, *Nitschke.*
Victoria Falls: Palm Kloof.
Distrib. America.

HYPOXYLON ANNULATUM, *Fr.*
Victoria Falls: Livingstone Island.
Distrib. America, Australasia.

ROSELLINIA AQUILA, *De Not.* (*Byssosphæria*, Cooke.)
Ladysmith, Natal; on decaying wood, Klip River.
Distrib. Europe, Asia, America.

MYXOGASTRES.

STEMONITES FUSCA, *Rost.*
Pietermaritzburg, Natal.
Distrib. Europe, Asia, America, Australasia.

STEMONITES FRIESIANA, *De Bary.*
Bloemfontein, near Sannah's Post, O.R.C.
Distrib. Europe, America.

ARCYRIA SERPULA, *Massee.*
Victoria Falls: Rain Forest. East London.
Distrib. Europe, Asia, America, Australasia.

CHONDRIODERMA DIFFORME, *Rost.*
Victoria Falls: Rain Forest. Umtali, East Rhodesia.
Distrib. Europe, Asia, Africa, America.

DIACHÆA LEUCOPODA, *Rost.*
Victoria Falls: Rain Forest. Mombasa, B.E. Africa.
Distrib. Europe, Asia, Africa, America.

TILMADOCHE NUTANS, *Rost.*
Victoria Falls: Palm Kloof. Umkomaas, near Durban.
Distrib. Europe, America, Australasia.

BADHAMIA VARIA, *Massee.*
Port Elizabeth, on decaying wood; East London, bright orange-yellow plasmodium on *Stereum.*
Distrib. Europe, America.

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NOTE ON THE COPROPHILOUS FUNGI.

(By THOMAS GIBBS.)

FOUR samples of the dung of wild animals gathered by Mr. Cheesman during his South African tour were entrusted to the writer for laboratory examination. Of the material sent one sample was that of the Hippopotamus, and gathered on Livingstone Island, Victoria Falls. The others were from the Matoppo Hills; the kind of animal to which they belonged was not ascertained, a circumstance not, however, of much importance for, as Massee

and Salmon * remark, coprophilous Fungi seem generally to be quite indifferent as to their particular hosts. One sample, however, was in small round pellets similar to rabbit-dung, the other two being of larger animals, all apparently belonging to herbivorous mammals.

The material was received by the writer in November 1905, and was treated as recommended by Massee and Salmon *, being kept under glass covers upon wet blotting-paper. The water used was sterilized by boiling to prevent infection by spores from outside sources. Notwithstanding their subtropical origin, the cultivations were carried on through a Derbyshire winter and spring in a room without a fire, but in a window warmed by the morning sun.

The first appearance of a fungus-growth was noticed soon after Christmas, when the round pellets mentioned above (which had for a few days been placed in a warm room) appeared as if sprinkled with soot owing to a profuse growth of *Saccobolus depauperatus*, Rehm. From this time for upwards of three months, indeed so long as the material was kept moist, the fungus crop continued, and fresh species appeared from time to time.

Altogether thirteen species were seen: of these, eight were of known species; one (*Coprinus Cheesmani*, Gibbs) is now described for the first time; of two others, (6) *Sordaria* sp. and (8) *Delitschia* sp., the portions seen were too fragmentary for certain recognition; while of two more, (2) *Coprinus* sp. and (13) *Ascophanus* sp., which could not be identified with any known species, the scanty material seen did not justify new specific diagnoses.

A full bibliography of the whole subject will be found in Messrs. Massee and Salmon's paper in the Oxford 'Annals of Botany,' xv. (1901) 353–355.

List of Fungi observed.

HYMENOMYCETÆ.

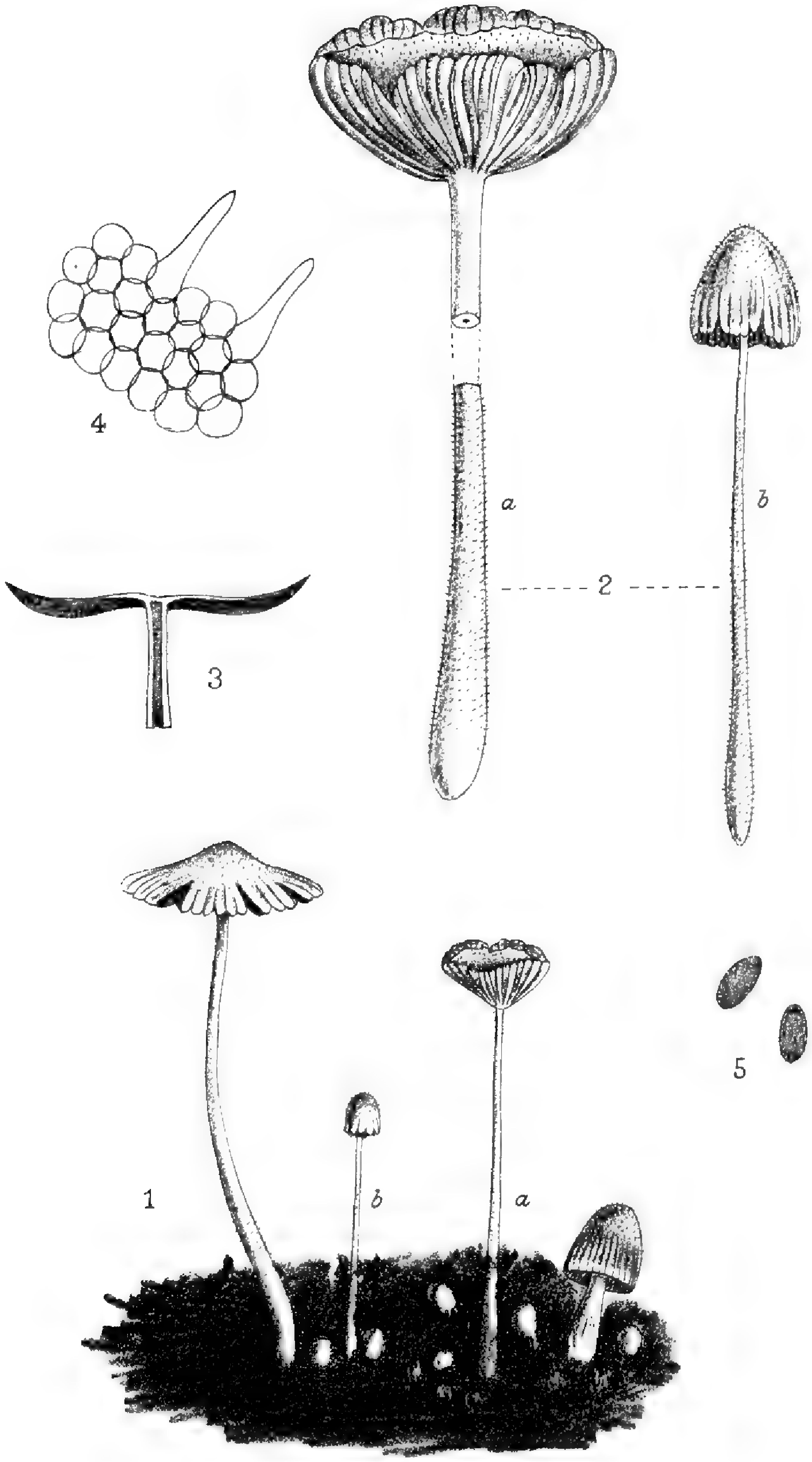
Agaricaceæ.

1. Coprinus Cheesmani, *Gibbs* (sp. nov.). (Plate 36.)

Livingstone Island, Victoria Falls.

C. pileo tenerrimo, aliquandiu ovato-campanulato, tunc expanso, umbonato, posthac sursum curvato, plicato-sulcato, tandem ad partem dorsalem lamellarum fisso, latitudine ad 23 mm., pallido-fulvo vel subrufo, disco obscuriore tandem depresso, pilis erectis hyalinis non septatis vestito. Lamellæ griseo-nigrantes adnatæ vel adnexæ angustæ, 50–70 numero in pileis majoribus.

* Massee, G., and Salmon, E. S., "Researches on Coprophilous Fungi," Annals of Botany, xv. 313–357, pls. 17, 18 (1901).



T. Gibbs del.
J. N. Fitch lith.

West, Newman imp.

COPRINUS CHEESMANI, *Gibbs.*

Stipes ad $4\frac{1}{2}$ cm. longitudine, circiter 1 mm. crassitudine, fistulosus, flaccidus, hyalinus, in parte inferiore dense pilosus, prope apicem glaber. Sporæ fusco-purpureæ, ellipticæ, polis obtusis, $12–16 \times 6–8\ \mu$.

Hab. in fimo Hippopotami.

This fungus appears to be closely allied to the well-known *Coprinus radiatus*, Fr., but is much larger in all its parts. The spore measurements given above cover what appears to be the normal range, but individual spores were seen $20\ \mu$ in length.

2. Coprinus sp.

Matoppo Hills.

Two specimens occurred of a very minute species. Pileus 1–2 mm., pallid, with rust-coloured scurfy patches. Stem $\frac{1}{2}$–1 cm. high, slightly hairy; spores elliptical, $11–15 \times 6–9\ \mu$. The material was not, however, sufficient for identification with any known species nor for a new specific diagnosis.

PYRENOMYCETÆ.

3. Sordaria curvula, *De Bary.*

Matoppo Hills.

Distrib. Europe, North America.

4. Sordaria pleiospora, *Wint.*

Matoppo Hills.

Distrib. Europe.

5. Sordaria platyspora, *Plowr.*

Matoppo Hills.

Distrib. Britain.

6. Sordaria sp.

A fungus allied to, but in some respects differing from, *S. anserina*, Wint.; it occurred on Hippopotamus-dung gathered on Livingstone Island, Victoria Falls.

7. Delitschia bisporula, *Hans.*

Matoppo Hills.

Distrib. Europe.

8. Delitschia sp.

Matoppo Hills.

Fragments, including large chestnut-brown spores, $45 \times 15\ \mu$, occurred on the dung of a large animal.

9. Sporormia intermedia, *Auersw.*
Matoppo Hills.
Distrib. Europe, North and South America.

10. Sporormia ambigua, *Niessl.*
Matoppo Hills.
Distrib. Europe, South America.

11. Sporormia pascua, *Niessl.*
Matoppo Hills.
Distrib. Europe.

DISCOMYCETÆ.

12. Saccobolus depauperatus, *Rehm.*
Matoppo Hills.
Distrib. Europe, North America.

Two forms occurred, a larger and a smaller, but both probably belonged to this species. The larger (ascophores $\frac{1}{4}$–$\frac{1}{2}$ mm. across, spores $13–16 \times 6–7\ \mu$) was so abundant on the small pellets like rabbit-dung that it appeared as if sprinkled with soot. The smaller form (ascophores up to $\frac{1}{4}$ mm., spores $10–12 \times 6–6\frac{1}{2}$) appeared on one of the other samples and was much less abundant.

13. Ascophanus sp.
Matoppo Hills.

A few ascophores occurred of a minute brick-red *Ascophanus*, which Miss A. Lorrain Smith considered nearest to though not identical with *A. granuliformis*, Boud. The material, however, was not sufficient to justify a new specific diagnosis.

A noticeable feature in the above list is the predominance of the Pyrenomycete family Sordariæ, 9 of the 13 species observed belonging to that family, a much larger proportion than is usual in a like gathering in England, where the leading place is more usually taken by the Ascoboleæ. The total absence of Hyphomycetæ and Mucoraceæ is also remarkable, and is perhaps explained by the prolonged desiccation the material had undergone, the conidia of these families being probably less able to withstand such conditions than are the spores of the more highly organised Basidiomycetæ and Ascomycetæ.

It will also be noticed as an interesting fact that eight of the thirteen species seen belong to known European species: this confirms the opinion

expressed by Massee and Salmon (*supra*) as to the wide distribution of individual species of coprophilous fungi.

It only remains for the writer to acknowledge his indebtedness to Miss A. Lorrain Smith for much assistance in determining species, and to Mr. G. Massee for assistance in the genus *Coprinus*.

EXPLANATION OF PLATE 36.

Fig. 1. *Coprinus Cheesmani*, Gibbs. Group of plants, nat. size.
Fig. 2. Plants marked "*a*" and "*b*" in fig. 1, × 3.
Fig. 3. Section slightly magnified.
Fig. 4. Cells of epidermis and hairs, × 200.
Fig. 5. Spores, × 400.

Gardenia Thunbergia and its Allies.

By Dr. Otto Stapf, F.R.S., Sec.L.S., and J. Hutchinson.

(Plate 37.)

[Read 18th June, 1908.]

The small group of plants which forms the subject of this paper is represented in the 'Flora of Tropical Africa,' vol. iii. pp. 100 & 101, by two species: *Gardenia Thunbergia*, L. fil., and *G. Jovis-tonantis*, Hiern; but under the former not less than five names originally intended for as many distinct species appear in the list of synonyms. As *Gardenia Thunbergia* was described from a Cape plant, and the reduced species from material collected mainly in the northern parts of Tropical Africa, the area of *G. Thunbergia* was assumed to cover practically the whole of Africa, with the exception of the temperate north. Guided by this assumption, subsequent authors were frequently led to refer to this apparently common and widely spread species, plants which differ from it at least as much as *G. Jovis-tonantis* does, and in some cases indeed much more. Thus *G. Thunbergia* grew more and more into a collection of incongruous forms. More recently three new species, evidently closely allied to *G. Thunbergia*, were described. They were not split off from that species, and in so far did not touch its composition; but, on the other hand, they made the incongruity of its components still more glaring, at least to those who had an opportunity of mustering a considerable accumulation of specimens of "*G. Thunbergia.*" Ample opportunity of this kind was given to Mr. Hutchinson, who during the last two years, under my direction, sorted and named the Rubiaceæ of the large African collections which had accrued to Kew. We therefore

conceived the idea of revising the whole group, and of placing its constituents on a more equal basis. For that purpose we studied, in the first place, the material at Kew; but we had also, of course, to direct our attention to the valuable material in the herbarium of the British Museum; we asked for and had, thanks to the courtesy of Dr. De Wildeman, the loan of the "*Gardenia Thunbergia*" specimens of the Congo State collections; and finally we availed ourselves of Mr. Casimir De Candolle's ever ready help for the elucidation of some critical species, the types of which were in the Candollean herbarium. We might have extended the field of our investigation, but for want of time and the conviction that after all the time had not yet come for attaining anything like finality. What we can and ought to do, in cases like the present, is to revise our knowledge from time to time and clear the basis for a further advance. Our paper is an attempt in this direction. The Gardenias of the "*Thunbergia*" group are rather striking objects when in flower, and it may be hoped that the collectors and field-students will, in the future, pay more attention to them, and supply us with more complete material and their own observations on the mode of growth, the range of individual variation, and any biological conditions which may influence their morphological characters.

The genus *Gardenia*, in the sense of Bentham and Hooker's 'Genera Plantarum,' consists of three sections: *Eu-Gardenia*, *Ceriscoides*, and *Rothmannia*. The first section ranges over the whole of the palæotropic region, and is represented in Africa by the *Gardenia Thunbergia* group—the subject of the present paper—and two more species which are characterised by long, almost cylindrical fruits. From the Indian, Malayan, and Polynesian species the "*Thunbergia*" group differs on the whole in the number of the placentas, which rarely falls below six, and the more or less abundant development, in the mesocarp, of sclerotic fibres, which in the endocarp fuse into a very hard woody shell, and finally in the more xerophilous structure of the leaves. The species forming this group are very closely connected. This and the very considerable variation in the size and shape of the leaves, the size of the flowers, and the degree of development of the calyx-teeth or lobes—even in the same individual—make the discrimination of the species very difficult if the specimens are scrappy or badly selected. The number of parts in the plan of the flower, though also subject to a certain amount of variation, is much more constant, and the same may be said of the surface condition and the nervature of the leaves, and the shape of the calyx-teeth or lobes. The very copious material of *G. Jovis-tonantis* which we had before us was most instructive in this respect. Then there are certain species which stand out from the rest on account of some special peculiarity, as the cucullate and more or less petioled sepals of *G. Thunbergia*, the cuff-like prolonged calyx-tube of *G. cornuta*, with its laterally attached segments, the

small flowers and ribbed fruits of *G. Aqualla*, and the almost entirely suppressed overground stems of *G. subacaulis* and *G. Tinneæ*. The two last-named species are interesting instances of adaptation of arborescent types to the peculiar edaphic conditions of the savannas.

With our present knowledge of *Gardenia* it would be idle to speculate on the phylogeny of the "*Thunbergia*" group. They certainly represent a distinct branch of the greater phylum of *Eu-Gardenia*, from which they must have become differentiated a very long time ago. We know nothing about the dispersal of their seeds except what can be inferred from the structure of their fruits and seeds, and the casual observations of the collectors. It seems that the fruits of some of them, at any rate, are eaten by elephants and antelopes, and probably other animals, evidently for the succulent pulp in which the seeds are embedded. The seeds would in this way get into the intestinal canals of those animals, and might finally be carried to great distances from the mother plant; but no means of transport across the seas suggest themselves, and it is evident that the Eu-Gardenias must have reached their areas, in so far as they are separated by water, at a time when those areas were still connected by land, that is in pre-Tertiary times.

In the following enumeration of the species of the "*Thunbergia*" group we have confined ourselves to describing only those which are new or were imperfectly known, the key which precedes the enumeration including sufficient characters for the determination of the others. In the key we have placed together two acaulescent species for purely practical reasons. They have no doubt descended independently from each other, *G. subacaulis* probably being more intimately connected with *G. asperula*, and *G. Tinneæ* with *G. lutea* and *G. ternifolia*. (OTTO STAPF.)

Key to the Species.

Subacaulis; flos solitarius cum foliis in rosulam dispositis.
- Folia scabrida; corollæ tubus 4–8 cm. longus .... 1. *subacaulis.*
- Folia lævia; corollæ tubus circiter 3·5 cm. longus................ 2. *Tinneæ.*

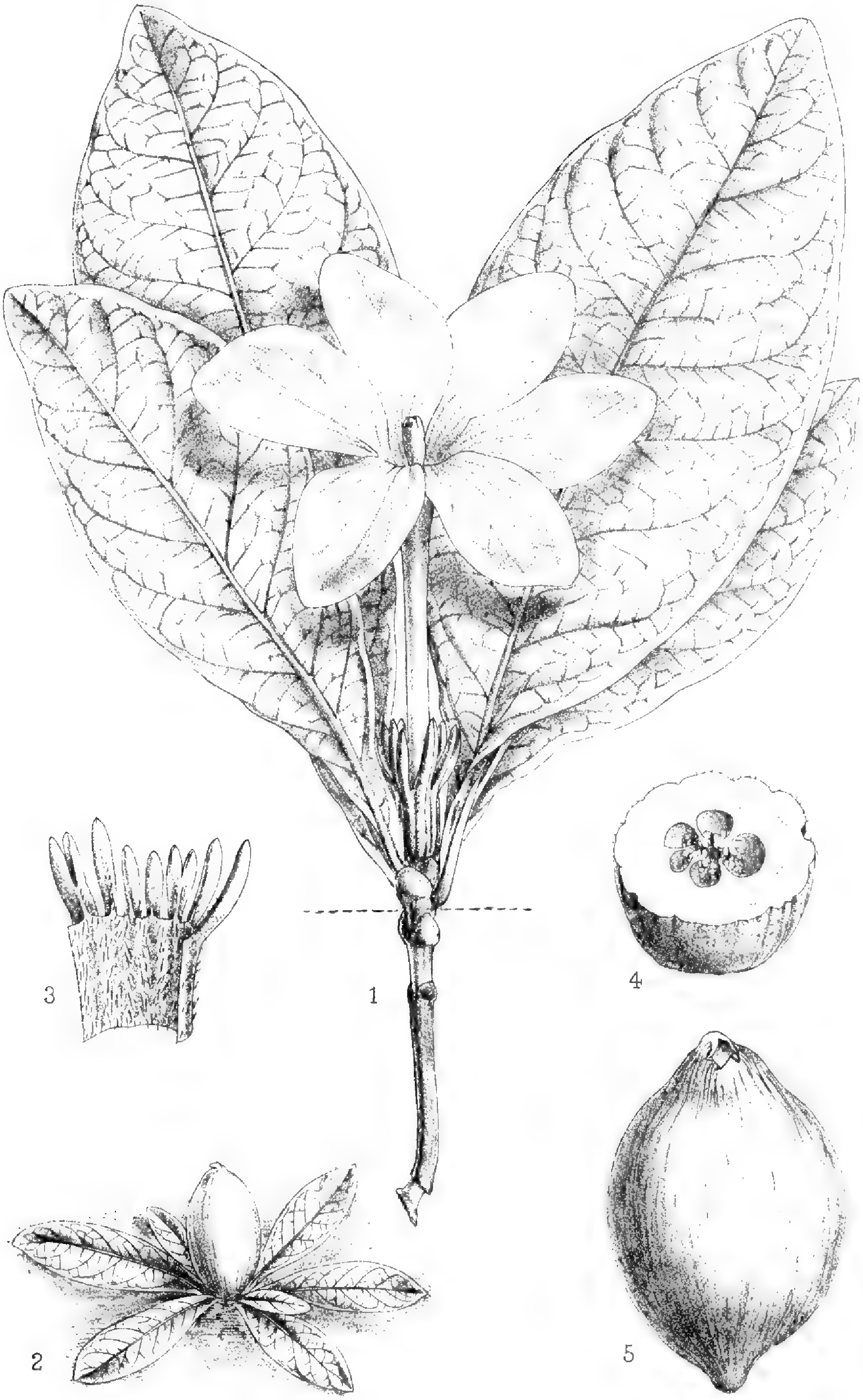
Arbores vel frutices.
- Corolla 8–9-mera.
  - Ovarium 9-merum.
    - Calycis tubus ultra 5 mm. longus, lobis oblongis .... 3. *Jovis-tonantis.*
    - Calycis tubus infra 3 mm. longus, lobis subfiliformibus demum reflexis .... 4. *Volkensii.*
  - Ovarium 3–6-merum.
    - Calycis lobi spatulati, infundibuliformes................ 5. *Thunbergia.*
    - Calycis lobi oblongi (non spatulati).
      - Calycis lobi lateraliter complanati, equitantes et decurrentes .... 6. *Saundersiæ.*
      - Calycis lobi dorsaliter complanati, non decurrentes .. 7. *asperula.*

Corolla 6–7-mera (raro 9-mera in *G. spatulifolia*).
Calycis tubus ultra loborum insertiones productus............ 8. *cornuta.*
Calycis tubus non ultra loborum insertiones productus.
Calycis lobi non filiformes; calyx et corolla fere glabra vel breviter pubescentia.
Folia lævia.
Folia late obovato-cuneata, nervis lateralibus ± flabellatis .... 9. *spatulifolia.*
Folia oblanceolata ad obovata, nervis lateralibus magis patulis quam in præcedente.
Folia arcte reticulata; fructus ellipsoideus, sæpe ± obtusus vel utrinque angustatus .... 10. *ternifolia.*
Folia laxe reticulata; fructus oblongo-ellipsoideus, ± stipitatus .... 11. *lutea.*
Folia scabrida.
Corollæ tubus quam lobi vix duplo longior .... 12. *triacantha.*
Corollæ tubus quam lobi triplo longior .... 13. *Goetzei.*
Calycis dentes filiformes; calyx et corolla magis minusve tomentosa.
Folia scabrida; fructus 3–4 cm. longus, multicostatus .. 14. *Aqualla.*
Folia lævia; fructus 6–9 cm. longus, ecostatus .... 15. *erubescens.*

1. GARDENIA SUBACAULIS, *Stapf et Hutchinson* (sp. nov.).

Suffrutex subacaulis, uniflorus. *Folia* sessilia, oblanceolata, basi longe attenuata, usque ad 15 cm. longa et 7 cm. lata, coriacea, apice rotundata, utrinque scabrida, marginibus undulatis, nervis lateralibus utrinque 9–14 patulis prominentibus, venis arcte anastomosantibus utrinque conspicuis; stipulæ late ovatæ, obtusæ, circiter 4 mm. longæ, coriaceæ, extus parce pilosæ. *Receptaculum* oblongum, circiter 1 cm. longum, puberulum. *Calyx* tubulosus, 6–9-lobus; tubus 8–10 mm. longus, extus fere glaber, intus parce pubescens; lobi oblongi vel lineares, obtusi, incrassati, a latere compressi, interdum subfoliacei, in tubo decurrentes, 2·5–8 mm. longi. *Corolla* alba, demum flava; tubus 4–8 cm. longus, medio 3–4 mm. diametro, extus minute pubescens, intus superne pubescens; lobi 6–8, oblique obovati vel elliptici, 2–3·5 cm. longi, 1–2 cm. lati, supra basin parce pubescentes. *Antheræ* 11–12 mm. longæ, inclusæ. *Stylus* 4·5–8 cm. longus, supra medium tenuiter pubescens, apice incrassatus, inæqualiter 6-lobatus, lobis latis obtusis circiter 2 mm. longis. *Ovarium* placentis 6. *Fructus* ambitu ellipticus, circiter 5 cm. longus, medio 3 cm. diametro; pericarpium fibroso-lignosum, 2 mm. crassum. *Semina* matura ignota.

Northern Rhodesia, and throughout Nyasaland:—Broken Hill, *Kässner*, 2020 feet (Herb. Mus. Brit.)! Kondome to Karonga, 2000–6000 feet, *Whyte*! plains near South Rukuru, 4000 feet, *McClounie*, 114! Upper Loangwa River, *Nicholson*! Mt. Malosa, 4000–6000 feet, *Whyte*! Namasi,



J. H. del.
J. N. Fitch lith.

West, Newman imp.

GARDENIA SUBACAULIS, *Stapf & Hutch.*

Cameron, 77! Manganja Hills, *Waller*! Eastern Nyasaland, *Archdeacon Johnson*, 498!

K. J. Cameron states that the flower of this species is pure white, but only remains so for a day, when it turns yellow and withers.

PLATE 37.

1. Whole plant in fruit (n. s.). 2. Plant in fruit, from collector's sketch (reduced to $\frac{1}{3}$). 3. Calyx cut open (× 2). 4. Section of ovary (× 5). 5. Mature fruit (n. s.).

2. G. TINNEÆ, *Kotschy et Heuglin, in Bot. Zeit.* (1865) p. 173, t. 8; *Kotschy et Peyr. Pl. Tinn.* p. 6, A, B.

Bahr-el-Ghazal; Bongo-land, *Tinne* and *Heuglin.*

3. G. JOVIS-TONANTIS, *Hiern, in Flora Trop. Afr.* iii. p. 101; *Ficalho, Pl. Uteis*, p. 198; *Hiern, Welw. Cat. Afr. Pl.* ii. p. 461.

Decameria Jovis-tonantis, Welw. Apont. p. 579, Nota 12, et Synops. Explic. p. 10, no. 20, et p. 18, no. 44.

From the Shari and Bahr-el-Ghazal to Uganda and Angola:—Central Shari; swamps of Baseli, *Chevalier*, 8582! Jur-land, *Schweinfurth*, 13! 1339! 1750! 2888! Wayo, in Muro Territory, *Petherick*!—Uganda; scattered woods near Changu, at the mouth of the Katonga River, *Scott Elliot*, 7472! without precise locality, in the jungle, *Wilson*, 146! Buddu, *Dawe*, 240! German East Africa; Marungu, *Volkens*, 2145! (Herb. Mus. Brit.).—Congo State; Lower Congo, without precise locality, *Smith*, 72! (Herb. Mus. Brit.), Mayombe, *Laurent*! Boma, *Laurent*! Matabi, *Ducoffre*! Cataract District; Bingila (?) *Dupuis*! without precise locality, *Laurent*! Luvituku, *Pynaert*, 79! Stanley Pool District; Stanley Pool, *Desmeuse*, 192! *Laurent*! N'Dembo, *Gillet*! Kisantu, *Gillet*! Leopoldville, *Pynaert*, 162! Lake Leopold District; Fini, *Laurent*! North East District; Route Guruza to Mangara (near Suronga), *Seret*, 389! Mapussi to Koko, *Seret*, 389! Lualaba District; Luila River, *Descamps*! Luluabourg, *Cambiers*! *Lescrauwaet*, 314! Eastern Province; Katanga, Lukofu, *Verdick*!—Angola; Catomba, *Welwitsch*, 2573! district of Malange, *Gossweiler*, 1237!

All the specimens quoted above from the Congo State, excepting that by *Smith*, are in the Brussels Herbarium, and were kindly lent us for examination by Dr. E. De Wildeman.

An interesting superstition exists amongst the natives of Angola regarding this species. Ficalho, in Fl. Uteis, p. 198, states:—"It is a small tree not exceeding 5–9 feet in height, but it has a relatively large trunk, and inhabits the stony, rather dry lands of Cazengo, Golungo Alto, and Ambaca. The wood is of a clear yellow colour, extremely hard, and of a notably fine grain. It is like boxwood—for which it might be substituted for many purposes,

perhaps even in engraving. The same species is met with in Huilla, particularly in the woods near the lake of Iabantala, where it attains larger dimensions. In those parts it is called *mulâbi*. It is one of the *fetish* plants. The negroes of the interior of Angola believe that it is a protection from lightning—perhaps in virtue of the great hardness of its wood, as Welwitsch observes—and are in the habit of putting the branches on the tops of their huts, believing that they thus obtain shelter from electrical discharges. From this supposed virtue Welwitsch derived the specific name of *Jovis-tonantis*, dedicating it to the God of Thunders."

According to Seret, the seeds yield a black dye for painting the skin. The wood is very hard, and is used for the manufacture of knife-handles.

Flowering specimens much resembling this species were collected by H. Waller at the foot of Morambala Hill, where the fruits form the favourite food of the elephants.

4. G. VOLKENSII, *K. Schum., in Engl. Bot. Jahrb.* xxxiv. (1904) p. 332.

German East Africa; sandy creeks of the coast; *Engler*, 2199, *Kirk*! (fruit in Kew Museum).

5. G. THUNBERGIA, *Linn. fil. Suppl.* p. 162 (descr. emend.).

Bot. Mag. t. 1004; Drapiez, Herb. Amat. Fl. vii. t. 554; Wood, Natal Plants, t. 40; Sims, For. Fl. Cape Col. t. 78. *Gardenia verticillata*, Lam. Encycl. 11. p. 607 (1786). *G. speciosa*, Salisb. Prod. Stirp. Hort. Chap. Allert. p. 63 (1796). *G. crassicaulis*, Salisb. Parad. Londin. i. t. 46 (1806). *Bergkias*, Sonnerat, Voy. N. Guin. p. 47, tt. 17, 18 (1776). *Thunbergia capensis*, Montin in K. Vet.-Akad. Handl. (Stockholm) xxxiv. (1773) p. 289, t. 11. *Piringa Caquepiria*, A. L. de Juss. in Mém. Mus. Par. vi. (1820) p. 399.

Arbuscula, 2·5 m. alta, vel frutex; rami cortice griseo vel albido tecti, etiam juniores glabri. Folia cum floribus coëtanea, rotundato-ovata vel obovata, breviter vel longius acuminata, acumine plerumque obtuso, basi cuneatim attenuata lamina magis minusve in petiolum brevem decurrente, 5–7 cm. longa, 3–4 cm. lata, papyracea, fere concoloria, glabra nisi in nervorum axillis pilosa, nervis lateralibus utrinque 5–7 tenuibus obliquis, venis laxis inconspicuis; petiolus 2–4 mm. longus; stipulæ in tubum connatæ, scarioso-membranaceæ, unilateraliter fissæ, demum circumscissiles, summæ ad 12 mm. longæ. *Flores* ad ramulorum breviorum apices, solitarii, sessiles inter ramulos orti. *Receptaculum* obconicum, 10–12 mm. longum, tenuiter sericeo-pubescens. *Calyx* tubulosus, 5–8-lobus; tubus superne uno latere fissus, extus glaber vel magis minusve appresse pilosus, intus densissime appresse tomentosus, ultra loborum insertionem breviter productus; lobi foliacei, breviter vel longiuscule petiolati, laminis spatulatis vel obovato-

oblongis vel ovatis basi infundibuliformibus 5–12 mm. longis, petiolis sæpe in tubo breviter decurrentibus. *Corollæ* albæ tubus cylindricus, 4–8 cm. longus, medio 3–4 mm. diametro, extus glaber, intus superne pubescens; lobi 8 (raro 9), oblique obovati vel obovato-oblongi, 2·5–4·5 cm. longi, 1·5–2·5 cm. lati, glabri. *Antheræ* medio affixæ, 22–23 mm. longæ, 4–5 mm. exsertæ. *Stylus* 5·5–9 cm. longus, a medio pubescens, sursum multo densius vestitus; stigmatis lobi obovato-oblongi, 6–7 mm. longi. *Ovarium* placentis 3–5. *Fructus* ellipsoideus, 4–5·5 cm. longus, 2·75–3·5 cm. diametiens, albidus; pericarpium durum, fibris lignosis crassiusculis creberrimis. *Semina* ∞, lenticularia, maiora 6–7 mm. diametro, nigra.

South Africa from Port Elizabeth to Natal:—Cape Colony, without precise locality, *Masson*! (Herb. Mus. Brit.). Port Elizabeth Div., Krakakamma, *Harvey*, 556! Somerset Div., *Bowkie*! Bathurst Div., between Theopolis and Port Alfred, *Burchell*, 4127. East London Div., in woods near the mouth of Buffalo River, *Leighton* in herb. Norm. Aust. Afr. no. 99! Natal; Inanda, *Wood*, 439! near Durban, *Wood*, 20! (Herb. Mus. Brit.). Without precise locality, *Cooper*, 2467! *Gerrard*, 50! Cult. in Hort. *Burchell*, 749! Hort. *Malcolm* (1797)! (Herb. Mus. Brit.).

6. G. Saundersiæ, *N. E. Brown, in Kew Bull.* 1906, p. 104.

South East Africa:—Gazaland; Lebombo Mountains, *Saunders*! Delagoa Bay; Rikaltu, *Junod*, 218!

7. G. asperula, *Stapf et Hutchinson* (sp. nov.).

Frutex vel arborescens, spinis validis (ramis commutatis). *Rami* juniores pubescentes, demum fere glabri. *Folia* lanceolato- vel elliptico-oblonga, rarius subobovata, sessilia, 4–6·5 cm. longa, 2–3 cm. lata, obtusa vel subacuta, tenuiter coriacea, utrinque puberula, nervis lateralibus utrinque 8–10 obliquis intra marginem arcuatis, utrinque prominentibus, venis conspicuis; stipulæ scariosæ, 2 mm. longæ, pubescentes. *Receptaculum* oblongo-obconicum, 5–10 mm. longum, brevissime pubescens. *Calyx* tubulosus, 6–9-lobus; tubus sæpe superne uno latere fissus, 9–12 mm. longus, extus brevissime pubescens, intus infra medium appresse tomentosus; lobi subfoliacei, oblongi vel spatulati, obtusi, ad 15 mm. (raro 20) longi et ad 4 mm. lati, interdum parte coaliti. *Corolla* alba, suaveolens; tubus cylindricus, 4–6 cm. longus, medio circa 3 mm. diametro, extus parce longe pilosus, intus fere glaber; lobi 6–9, oblique obovati, 2–3 cm. longi, 1–1·5 cm. lati. *Antheræ* 1–2 cm. infra faucem insertæ, medio affixæ, 10–13 mm. longæ. *Stylus* 4·5–8 cm. longus, supra medium pubescens, infra medium fere glaber; stigmatis lobi exserti, complanati, oblanceolati, obtusi. *Ovarium* placentis 6. *Fructus* pyriformis, durus (fide *Swynnerton*).

Nyasaland to South-East Rhodesia :—British Central Africa ; Lake Shirwa, *Meller* ! Shire Highlands, *Buchanan*, 174 ! Portuguese Nyasaland ; between Unango and Mt. Mtonia, *Archdeacon W. P. Johnson* ! South-East Rhodesia, Melsetter District, open woods at Chirinda, *Swynnerton*, 56 ! (Herb. Mus. Brit. ; fruit in carp. coll.). Chihere Hills, 3500 ft., *Swynnerton*, 56 ! (Herb. Mus. Brit.). Chindas name, 'Chindharara' ; Singum name, 'Isivaluangwhii.'

A specimen collected by the Hon. Mrs. E. Cecil in Matabeleland near Enkeldoorn, no. 88, has quite the facies of *G. asperula*, excepting the more obovate leaves and narrow calyx-lobes. It is described by her as a bush 8–10 feet high, with ivory-white or pale-yellow flowers.

8. G. CORNUTA, *Hemsl., in Hook. Ic. Plant.* t. 2809.

South-East Africa :—Gazaland, Lebombo Mountains, *Saunders* ! Natal and Zululand, *Gerrard*, 1620 !

9. G. SPATULIFOLIA, *Stapf et Hutchinson* (sp. nov.).

G. Thunbergia, K. Schum. in Baum Kunene-Samb. Exped. p. 385 (non Linn. f.).

Arbor circiter 7 m. alta. *Rami* glabri. *Folia* obovato-spatulata, basi cuneata, 3–9 cm. longa, 2–5 cm. lata, apice rotundata, vel breviter obtuse acuminata, chartacea, utrinque glabra vel leviter scabrida, nervis lateralibus 5–11 fere flabellatim divergentibus utrinque prominentibus, venis utrinque conspicuis ; stipulæ latæ, scarioso-pubescentes, circiter 2 mm. longæ. *Receptaculum* oblongum, 1 cm. longum, breviter pubescens. *Calyx* tubulosus ; tubus spathaceus vel cylindricus, 7–14 mm. longus, extus glaber vel breviter pubescens, intus pilosus ; lobi 7–9, spatulati et tunc foliacei vel magis minusve reducti et lineares, usque ad 1·5 cm. longi et 8 mm. lati, interdum minuti, in eodem calyce variabiles, glabri. *Corolla* primo pallide, demum saturate flava ; tubus cylindricus, 5–7·5 cm. longus, medio circiter 3 mm. diametro, extus glaber, intus glaber vel superne parce pubescens ; lobi 6–7 (raro 9), elliptici vel oblique obovati, 2–5 cm. longi, 1·5–3 cm. lati, glabri. *Antheræ* 2 cm. longæ, 1·5 cm. infra faucem insertæ. *Stylus* 5–8 cm. longus, pubescens ; stigmatis lobi 6, 4–7 mm. longi, obtusi. *Ovarium* placentis 6. *Fructus* ignotus.

Tropical South Africa, from the Cunene to Gazaland :—Mossamedes ; Bumbo, *Welwitsch*, 2579 ! (Herb. Mus. Brit.). Cunene River, *Johnston* ! Chihinde, *Baum*, 39 ! Bechuana Land ; Lake Ngami, *Atherstone*, 34 ! Botletle River, *Lugard*, 7 ! South Africa, without precise locality, *Chapman & Baines* ! Rhodesia ; Sebakere tree 15–20 feet, flowers cream-coloured, sweet-scented, alt. 4000 ft., *Eyles*, 175 ! (Herb. Mus. Brit.). Gazaland ; Sabi River, *Swynnerton*, 715 ! (Herb. Mus. Brit.).

Baum (Kunene-Sambesi Exped. p. 19) observes that this tree is frequent from the Lower Kunene to the Kuito River, mostly growing in the valleys of the rivers. The tree attains rarely more than 15–18 feet, having a short stem with a greenish bark, and a large dense and rounded top. The fruits are eaten by the Kudu Antelope, and the hard wood is used by the natives for making handles, &c. The tree is known to the Boers as 'stumpdorn.'

10. G. TERNIFOLIA, *Schum. et Thonn. Beskr. Guin. Pl.* p. 147 (descr. emend.).

Arbor vel frutex divaricatus, 2–5 m. altus. *Rami* glabri. *Folia* oblanceolata vel obovata, sessilia, subacuta vel rarius rotundata, basi cuneata, 4–9 cm. longa, 2–4·5 cm. lata, subcoriacea, utrinque glauca, glabra, nervis lateralibus utrinque 7–11 obliquis, venis utrinque prominentibus arcte anastomosantibus; stipulæ late ovatæ, 2 mm. longæ, glabræ. *Receptaculum* oblongum vel oblongo-obconicum, 6–10 mm. longum, glabrum. *Calyx* tubulosus, subtruncatus vel 6-lobus; tubus 8–15 mm. longus, utrinque glaber; lobi oblongi, usque ad 5 mm. longi, obtusi, glabri, interdum minuti. *Corolla* flava; tubus cylindricus, 4·5–9 cm. longus, medio 2–3 mm. diametro, utrinque glaber; lobi 6, oblongo-elliptici, 2·5–5 cm. longi, 1–2·5 cm. lati, utrinque glabri. *Antheræ* 1·5 cm. longæ, 1·5 cm. infra faucem insertæ. *Stylus* 5–9 cm. longus, breviter pubescens; stigmatis lobi 5–6, usque ad 5 mm. longi, exserti. *Ovarium* placentis 6. *Fructus* ambitu oblongo-ellipticus, 5–7 cm. longus, usque ad 5 cm. diametro; pericarpium fibrosum, 1 cm. crassum. *Semina* subglobosa, maiora circa 4 mm. diametro, fulva.

Nigeria to the Gold Coast:—Northern Nigeria; Kuka, Bornu, *E. Vogel*, 92! Katagum District, *Dalziel*, 162! 161 (in part; fruiting specimen)! Zungeru, low bush, *Elliott*, 30! *Dalziel*! Nupe Country, *Baikie*! *Barter*, 1205! Southern part of N. Nigeria, without precise locality, *Kentish-Rankin*! Southern Nigeria; Oloke Meji, 6 feet high, flowers white, *Dodd*, 401! Gold Coast; Accra (Gah) and Adampi, *Thonning*! (Herb. DC.).

11. G. LUTEA, *Fresen. in Mus. Senckenb.* ii. (1837) p. 167 (descr. emend.).

G. Thunbergia, Engl. Hochgeb. Fl. Trop. Afr. (non Linn. f.).

Arbor vel frutex magnus. *Rami* tenuiter pubescentes. *Folia* 3–4-na, verticillata, sessilia, obovato-oblonga, obtusa, basin versus angustata, 4–13 cm. longa, 2–5 cm. lata, coriacea, glabra, fere concoloria, utrinque nitida, nervis lateralibus 8–12 patulis vel interdum leviter obliquis, venis laxis utrinque conspicuis (præcipue subtus); stipulæ scariosæ, late ovatæ, pubescentes, usque ad 4 mm. longæ. *Receptaculum* oblongo-obconicum, 5–8 mm. longum, glabrum vel pubescens. *Calyx* tubulosus, 6–7-lobus; tubus cylindricus, sæpe superne uno latere fissus, extus glaber vel pubescens, intus glaber vel

breviter pilosus; lobi 6–7, lineares, in tubo breviter decurrentes, usque ad 5 mm. longi, glabri. *Corolla* flava; tubus cylindricus, apicem versus leviter dilatatus, 5–9 cm. longus, medio 1·5–3 mm. diametro, utrinque glaber; lobi 6–7, elliptici vel obovato-oblongi, 2·5–3·5 cm. longi, 1–2 cm. lati, utrinque glabri. *Antheræ* 1·8 cm. longæ, 1·5 cm. infra faucem insertæ. *Stylus* inferne minute pubescens, apice incrassatus, 5·5–9 cm. longus; stigmatis lobi oblongi, obtusi. *Ovarium* placentis 6. *Fructus* ambitu oblongo-ellipticus, 4–6 cm. longus, breviter stipitatus, 2–3 cm. diametro; pericarpium fibroso-lignosum, circiter 5 mm. crassum. *Semina* ellipsoidea, 4 mm. longa, glauca.

From Abyssinia and the Sudan to S.W. Uganda and East Africa:—Sudan; 'Upper Nile,' *Freeman & Lucas*, 64! Blue Nile, near Abon Shendi, *Muriel*, 27! Bahr-el-Ghazal Prov., *Broun*! 'Aethiopia,' *Kotschy*, 540! Abyssinia; Hamedo, *Schimper*, 883! (Herb. Mus. Brit.); near Adde Bahara, *Schimper*, 523! mountains near Djeladjeranne, *Schimper*, 1821! without precise locality, *Quartin-Dillon & Petit*, 128! Foggaro Prov., *Steudner*, 903! Gallabat, *Schweinfurth*, 1457! Matamma, *Schweinfurth*, 1459! (Herb. Mus. Brit.). Fasokl, *Kotschy*, 540! Uganda; Madi, *Speke & Grant*, 762! Ankole Hills (fruit spec.), *Dawe*, 240! between Lake Rudolph and Gondokoro, *Donaldson Smith*! (Herb. Mus. Brit.). German East Africa; Kilwa, *Kirk*!

According to Capt. Speke ('Nile Journal,' Append. p. 636) the roots of this species boiled with the flour of *Andropogon Sorghum* are considered by the 'Wanyamwezi' to be a cure for hæmaturia; the contorted branches make an impenetrable fence.

12. G. TRIACANTHA, *DC. Prod.* iv. p. 382; *Williams, Florula Gambica, in Bull. Herb. Boiss.* sér. II. vii. (1907) p. 377.

G. macrocarpa, Carey, ex Voight, Hort. Suburb. Calcutt. p. 379.

From the Senegal to Sierra Leone:—Senegambia; *Roger*! *Leprieur & Perrottet*! (Herb. DC.); north bank of Gambia, *Ozanne*, 7! *Whitfield* (in part)! (Herb. Mus. Brit.). Sierra Leone, *Smythe*, 1!

We are much obliged to M. Cas. De Candolle for the loan of the type which enabled us to confirm Mr. Williams's conception of it as a distinct species.

According to Voight the plant described by Carey as *G. macrocarpa* was raised at Sibpure from seed received from Loddiges & Co. in 1822. This was the year when (Feb. to April) G. Don collected in Sierra Leone for the Horticultural Society of London, and it is very probable that Loddiges obtained the seeds from him.

13. G. Goetzei, *Stapf et Hutchinson* (sp. nov.).

Frutex vel arborescens. *Rami* dense tomentosi, deinde cortice flavescente tecti. *Folia* sessilia, obovata, apice rotundata, 2–6 cm. longa, 1·5–4 cm. lata, tenuiter coriacea, utrinque scabridula, nervis lateralibus utrinque 8–11 subpatulis utrinque prominentibus, venis arcte anastomosantibus; stipulæ breviter vaginantes, truncatæ, extus tomentosæ. *Receptaculum* oblongum, 5 mm. longum, dense pubescens. *Calyx* tubulosus, 6-lobus; tubus superne uno latere fissus, 1 cm. longus, utrinque tenuiter pubescens; lobi oblanceolati, obtusi, ad 1 cm. longi et 2 mm. lati, glabri, in tubo decurrentes. *Corollæ* tubus cylindricus, 3–5 cm. longus, medio 3 mm. diametro, utrinque tenuiter pubescens; lobi 6, ovato-elliptici, obtusi, 1–1·5 cm. longi, 5–10 mm. lati, utrinque parce pilosuli. *Antheræ* circiter 1 cm. longæ, 8 mm. infra faucem insertæ. *Stylus* 3–4 cm. longus, parce pubescens; stigmatis lobi 8 mm longi, fere inclusi. *Ovarium* placentis 6. *Fructus* ignotus.

German East Africa:—Ulunguru, Kissaki-Steppe, *Goetze*, 44!

14. G. Aqualla, *Stapf et Hutchinson* (sp. nov.).

Frutex ramosissimus, 1–2·5 m. altus, ramis subprostratis (*fide* Schweinf.). *Folia* magnitudine valde variabilia, oblanceolata vel (minora) elliptica, 2·5–18 cm. longa, 1–5 cm. lata, apice rotundata, rarius obtuse subacuminata, supra scabrida, subtus hispidula, coriacea, nervis lateralibus utrinque 14–17 præcipue subtus distinctis; stipulæ late triangulares, 4 mm. longæ, pilosæ. *Receptaculum* oblongum, 6 mm. longum, dense appresse pubescens. *Calyx* tubulosus, 6-lobus; tubus cylindricus, 8 cm. longus, utrinque appresse pubescens; lobi lineari-subulati, 3–4 mm. longi, subacuti, pubescentes. *Corolla* alba, demum citrina; tubus cylindricus, 2·5–4 cm. longus, medio 2 mm. diametro, extus dense appresse pubescens, intus tenuiter pilosus; lobi 6, oblique ovati vel elliptici, 2–2·5 cm. longi, 1–1·5 cm. lati, extus parce pubescentes, intus glabri. *Antheræ* 5 mm. infra faucem insertæ, 1 cm. longæ. *Stylus* 4·5 cm. longus, pubescens; stigmatis lobi brevi, obtusi. *Ovarium* placentis 6. *Fructus* ambitu ellipticus, costatus, 3·5–4 cm. longus, 1·5–2 cm. diametro; pericarpium durum, 3 mm. crassum, brunneo-maculatum.

From the Bahr-el-Ghazal to Yoruba:—Jur-land; Seriba Kurschuk Ali, *Schweinfurth*, 1751! Seriba Ghatta, *Schweinfurth*, 1969! at Okel, *Schweinfurth*, 1761! (Herb. Mus. Brit.). Upper Ubangi; Snussi Country, Ndelle, *Chevalier*, 8071! Nigeria; Katagum and district, *Dalziel*, 352! Yoruba, low spreading shrub, not frequent (fruit spec. only), *Barter*, 1234!

15. G. ERUBESCENS, *Stapf et Hutchinson* (sp. nov.).

G. triacantha, DC. var. *parvilimbis*, Williams, in Bull. Herb. Boiss. sér. II. vii. (1907) p. 378.

Arbor 5–6·5 m. altus, cortice platanoideo (*fide* Schweinf.). *Rami* juniores dense sericeo-tomentosi. *Folia* late obovata vel oblanceolata, basi cuneata, 4·5–16 cm. longa, 2–9 cm. lata, chartacea, utrinque glabra, supra interdum purpurascentia, subtus glauca, nervis lateralibus 6–8, venis supra sæpius distinctis subtus inconspicuis; petioli usque ad 4 mm. longi; stipulæ latæ, 3 mm. longæ, tomentosæ. *Receptaculum* oblongum, 4–8 mm. longum, dense tomentosum. *Calyx* tubulosus; tubus 6–12 mm. longus, dense tomentosus, demum subglaber, intus longe pilosus, dentibus 6 filiformibus 6–10 mm. longis. *Corolla* pallida, demum citrina (*fide* Schweinf.); tubus cylindricus, 2·5–7·5 cm. longus, medio circa 3 mm. diametro, utrinque tenuiter pilosus; lobi 6, elliptici, 2–3 cm. longi, 1·5 cm. lati. *Antheræ* 6, fere inclusæ, 7 mm. infra faucem insertæ, supra medium affixæ, 2 cm. longæ. *Stylus* 3–7 cm. longus, breviter pilosus; stigmatis lobi oblongi, obtusi, 3–5 mm. longi. *Ovarium* placentis 6. *Fructus* ambitu oblongo-lanceolatus vel fere ellipticus, 5–8 cm. longus, 2·5–3 cm. diametro.

From the Bahr-el-Ghazal to the Senegal:—Mittu-land; at Reggo, *Schweinfurth*, 2792! French Sudan; Nigalia, *Chevalier*, 160! Northern Nigeria; Kontagora, common in the bush, *Dalziel*, 224! Katagum District, *Dalziel*, 161 (in part; flowering specimen)! French Guinea; Samu Country, near Tombia, in bush near the village, *Scott Elliot*, 4370! near Wallia, *Scott Elliot*, 4574! Gambia; *Whitfield* (in part)! (Herb. Mus. Brit.).

Altitude and Distribution of Plants in Southern Mexico. By HANS GADOW, M.A., Ph.D., F.R.S. (Communicated by Dr. A. B. RENDLE, M.A., F.L.S.)

(With two diagrams.)

[Read 18th June, 1908.]

PROFESSOR A. HEILPRIN, in his very important paper, "The Temperate and Alpine Floras of the giant Volcanoes of Mexico" *, makes the following summarising statement:—"The preponderating element in the upper Mexican flora [from 10,000 feet upwards] is made up of forms which distinctly represent the temperate and arctic regions, and not of modifications, suited to a more rigorous climate, of the lower or basal floras of the same region. This condition characterises the high mountain floras of tropical regions generally, as distinguished from those of temperate climes." He refers to Engler † as the originator of this view, and continues: "Most of the Mexican plants occurring above 10,000 feet are specifically distinct from the congeneric forms of temperate North America, while about 10 per cent. of the species of high Mexican mountains are identical with those of the much more distant Andean summits."

According to Engler the alpine plants of Mexico are not connected with the plants of the subtropical and tropical regions of the same country, and he says further that, "whilst in California and on the Rocky Mountains part of the alpine flora is indeed derived from that of the plains, this is not the case in Mexico, because there the plants of the lower regions vegetate during the whole year. It is impossible for them quickly to acquire an organisation necessary for a prolonged period of rest, or the means of protection necessary for defence during such a time of rest. The plants of California's plain are already organised for enduring a prolonged and more or less inclement period, so that their descendants can gradually acquire the features necessary upon the new highlands."

These statements, probably as correct as they are ingenious, yet convey a somewhat erroneous impression, because they are incomplete and too general. If the alpine flora of a mountain in the tropics has not been derived from its base, it can have got to the top in two ways only—either by accident (wind, animals), or as a relic. The latter notion resorts, of course, to a glacial period as the favourite explanation; its importance has been greatly exaggerated, and good instances of arctic, even subarctic, animals and plants as derelicts on subtropical, leave alone tropical, mountains are exceedingly

* Proc. Amer. Phil. Soc. Philadelphia, xxx. 1892, pp. 4-22.

† Versuch einer Entwicklungsgeschichte der Pflanzenwelt, ii. 1882.

rare. Within subarctic and temperate countries such cases are naturally more common, although even there the principle has been greatly exaggerated. In either case, relics or accidental,—restricting ourselves to the Mexican mountains, the species should be presumably the same on the tropical tops and in the more distant arctic regions. But if the top flora has been derived from the basal, by modification, then there is every reason for suspecting that the plants should be specifically different. This is actually the case, to a great extent. Such a top flora may assume even an arctic facies, by convergence, by adaptation to similar environmental conditions.

Engler's explanation of the Californian and Rocky Mountain floras applies also to Mexico. Without exception the highest mountains of this country arise from the plateau, at least with one side, whilst the other, most conspicuously on Citlaltepetl, slides right into the tropics. Now, this plateau gives the temperate and cool flora a very good lead, so much, indeed, that the implied change into alpine species need be but very gradual, and the huge central plateau sloping from 7000 feet in the south to 3000 in the north, whilst maintaining continuity all along the backbone of the western Sierra Madre, insures an ideally perfect continuity of the same conditions from California, Arizona, and Sonora (the ancient Sonoraland, which stood out long before the rest of Mexico came into existence during the later Cretaceous epoch) to the truly alpine heights which now border the southern edges of the plateau.

So far, then, it must have been easy for plants of temperate North America to spread to the high Mexican mountains, but the distance is great and physical conditions have changed, and after all the bionomic conditions of the Mexican highlands are not the same as those of the United States, even if the mean temperatures be the same: consequently most of the congeneric plants have become specifically distinct. But this same high Mexican plateau is possessed also of a great number of endemic, autochthonous plants, many of which have sent representatives into the alpine regions. Consequently these have received part of their flora from the immediate adjoining basal regions or plains. If these mountains were isolated, if they did arise as solitary cones out of the tropics, the investigation would be simple. We should have to deal only with those species, about 10 per cent. according to Heilprin, which they have in common with some of the Central American peaks, *e. g.* Irazu, and with the distant Andes; plants which owe their scattered, high-level distribution possibly to wind, birds, and similar accidental agencies.

But the high Mexican mountains stand in a very peculiar condition, namely on the edge of the plateau. For instance, on the west side of Citlaltepetl it rises gradually from 7500 to 9000 feet before we come to the shoulder of the giant, while the south-eastern side glides much more rapidly into the tropics. These mountains have, in fact, two base levels, one of them

being the plateau; the other, for instance, on the Sierra de Ajusco, which forms the southern border of the Valley of Mexico, finds its southern level in the plain of Cuernavaca, about 5000 feet, thence sloping further into the tropical Balsas basin. Similar conditions apply to Popocatepetl and to the Nevado de Colima.

Consequently all these mountains possess a very mixed flora. First, northerners (or shall we call them long migrants?); secondly, endemic ascendants from a temperate or cool immediate base; thirdly, southerners, or ascendants from the tropics; fourthly, the "Andines." It is difficult, perhaps impossible, to keep the main categories asunder, since the distinction between hot, temperate, cool and cold is arbitrary. Specialists in American plants will be able to do it better than the present writer, who has but little, secondhand, botanical knowledge.

Yet the attempt has been made to group the flora of Mexico into several main categories.

1. Northern plants *, with their presumable home in the temperate northern hemisphere.
2. Endemics of Mexico, which again naturally fall into a cool to temperate and a tropical or "Southern" category.
3. Southerners are of course also those which for the sake of shortness we refer to as Andines, leaving the question of their original home in abeyance; for instance, *Acæna* (Rosaceæ), *Tauschia* (Umbelliferæ), *Pernettyia* (Ericaceæ), *Chionolæna* (Compositæ). Those which occur on Mexican high mountains do not, as a rule, extend further north, whilst they are found also in Central America and in South America, especially on the Andes.

I had no idea what the outcome would be of the necessary, almost endless, calculations and plottings, and yet they assumed a shape apparently so reasonable that it can scarcely be accidental. Thanks mainly to Heilprin the flora from 10,000 feet upwards is fairly well known, and his lists proved of the greatest value. But thence downwards all available data are vague. Papers like that by Liebmann on Citlaltepetl ('Botanische Zeitung,' 1844), and Kotschy's "Survey of Mexican Plants," Sitzungsberichte Wien. Akad. Wiss., Feb. 1852, viii. (partly suppressed!), are very scarce; and unfortunately altitudinal distribution does not seem to have appealed much to the authors of the 'Biologia Centrali-Americana,' at least I have failed to find therein such general conclusions as I had, perhaps unreasonably, been looking for. The fourth of the volumes on Botany, more especially pp. 145–151 and 282–315, by W. B. Hemsley, forms nevertheless the main supply of data for

* For instance *Pinus, Abies, Juniperus, Alnus, Quercus, Sambucus, Platanus, Ulmus, Cornus, Viscum, Veratrum, Pinguicula, Spiræa, Thalictrum, Aquilegia, Delphinium, Pyrola.*

this investigation. In this I have restricted myself to Phanerogams, minus Grasses, and I have assumed * for the Southern third of Mexico, *i. e.* from 21 degrees North to the Isthmus railway of Tehuantepec :

1600	species as found in the tropics.		
2500	„	„	in the temperate belt, up to 7000 feet.
1300	„	„	thence upwards.
200	„	„	at 10,000 feet level, according to Heilprin.

Heilprin has ascended and thoroughly investigated Citlaltepetl, Popocatepetl, Hztaccihuatl, and the Nevado de Toluca. I myself have ascended the first two (with camps at 8500 and at 12,500 feet level) and the Nevado de Colima ; of lower mountains the Sierra de Ajusco up to 10,000 feet, the Sierra Madre del Sur, above Omilteme near Chilpancingo, to about 9000 feet, and the Cerro de San Felipe near Oaxaca, of the same height.

Let us start with the 10,000 feet level. Heilprin mentions 117 genera with 199 species. Of these, leaving a few genera unclassed, there are about 62 Northern, 42 endemic, temperate and high-level ascendants, and 10 Southern ascendants and Andines.

Thence upwards we notice a rapid decline. At 12,000 feet the genera are reduced to 29, namely 21 Northerners, 3 endemic temperate (*Echeveria*, *Arctostaphylos*, *Pentstemon*), 4 Andines (*Colobanthus*, *Acæna*, *Pernettyia*, *Alchemilla* ?), and 1 Southern (*Ageratum*).

At 13,000 feet the genera are reduced to 17, namely 12 Northern, 2 endemic temperate (*Echeveria*, *Arctostaphylos*), and 3 Andines, *Colobanthus* having dropped out, and the southern *Ageratum* is likewise soon falling behind.

At 14,000 feet the 15 genera are composed of 11 Northerners, 3 Andines and the *Echeveria*.

Above 14,000 feet are only *Arenaria*, 2 *Senecio*, *Castilleia*, *Echeveria*, and *Chionolæna* ; in all 5 genera with 6 species. Engler (*op. cit.* p. 223) mentions *Alchemilla tripartita* for this high level on the Orizaba mountain. Only *Arenaria bryoides*, *Chionolæna lavendulacea*, and *Alchemilla tripartita* reach the snow-line.

The tree-line lies between 13,500 and 14,000 feet, but since the only trees (*Pinus Montezumæ*) are scattered for the last few hundred feet, the tree-line does not affect the few other plants.

Whilst at the 10,000 feet level the 62 Northern genera are still almost

* The numbers are necessarily vague and the tropical element of the Mexican flora is still very imperfectly known. These circumstances may, I trust, be an excuse for those corrections in my calculations which future research will no doubt find necessary. The principles which I have tried to draw attention to will, however, not be affected.

balanced * by the 53 others, at 13,000 feet the Northerners have rapidly gained the preponderance, owing almost entirely to the rapid falling behind of the endemic ascendants, which are now reduced to the solitary *Echeveria.* This is very significant, as it seems to indicate that the native basal genera find it more difficult to adapt themselves to these arctic heights than do the long migrants, the Northerners, which were already prepared for such eventualities, to put the matter in homely language. But it is equally significant that the Andines, although always few in numbers, hold their own. Thus it comes to pass that above 14,000 feet the few Northern plants are balanced by the others, and that near the snow-line a solitary Northern *Arenaria* is confronted by the Andine *Chionolæna* and by an *Alchemilla.*

From 10,000 feet downwards species and genera increase rapidly. This is not so much a fancy level as it would appear from the round number in feet, or 3100 metres. It fairly well marks the average top level of the main cloud-belt with its resultant moisture. Various calculations, notably at 9500 feet, at 8500 feet at our Xometla camp, and at 7000 feet, indicate that the increase is rather steady, and it seems that the absolute maximum of species is reached somewhere between 4000 and 5000 feet, the level of Orizaba. It is therefore possible to construct a curve from the 4500 feet level with 2500 species to the 10,000 feet level with 200 species. Further, it stands to reason, first, that the number of Southern species, which of course have their maximum in the tropics, decrease steadily from that base upwards ; secondly, that the Northerners decrease steadily to sea-level, where we are not far wrong in assuming that they represent less than 5 per cent. of the plants found in the true tropics. But it is very difficult to ascertain in which level lies the absolute maximum of the Northerners. It lies, of course, not as low as 4500 feet, that is quite obvious, not even at 5000 feet. On the other hand, it does not stand at 9000 feet, since thence *downwards* Northern species and genera show a rapid *increase.* The mean between the two limits is 7000 feet, and this seems to agree fairly with actual conditions. It marks, moreover, the lower level of the cloud-belt, at least on the sides away from the plateau, with the average height of which it also coincides, and this is an important point. Lastly, broadly speaking, this level marks the change from the Oak to the Pine belt.

All such calculations must be vague ; they are to a bewildering extent influenced by local conditions. On the northern side of Citlaltepetl, Popocatepetl, and Nevado de Colima the floral aspect is much more Northern than it is at the same level on the south slopes which are in direct communication with the tropics. The plateau side of Citlaltepetl strikes one

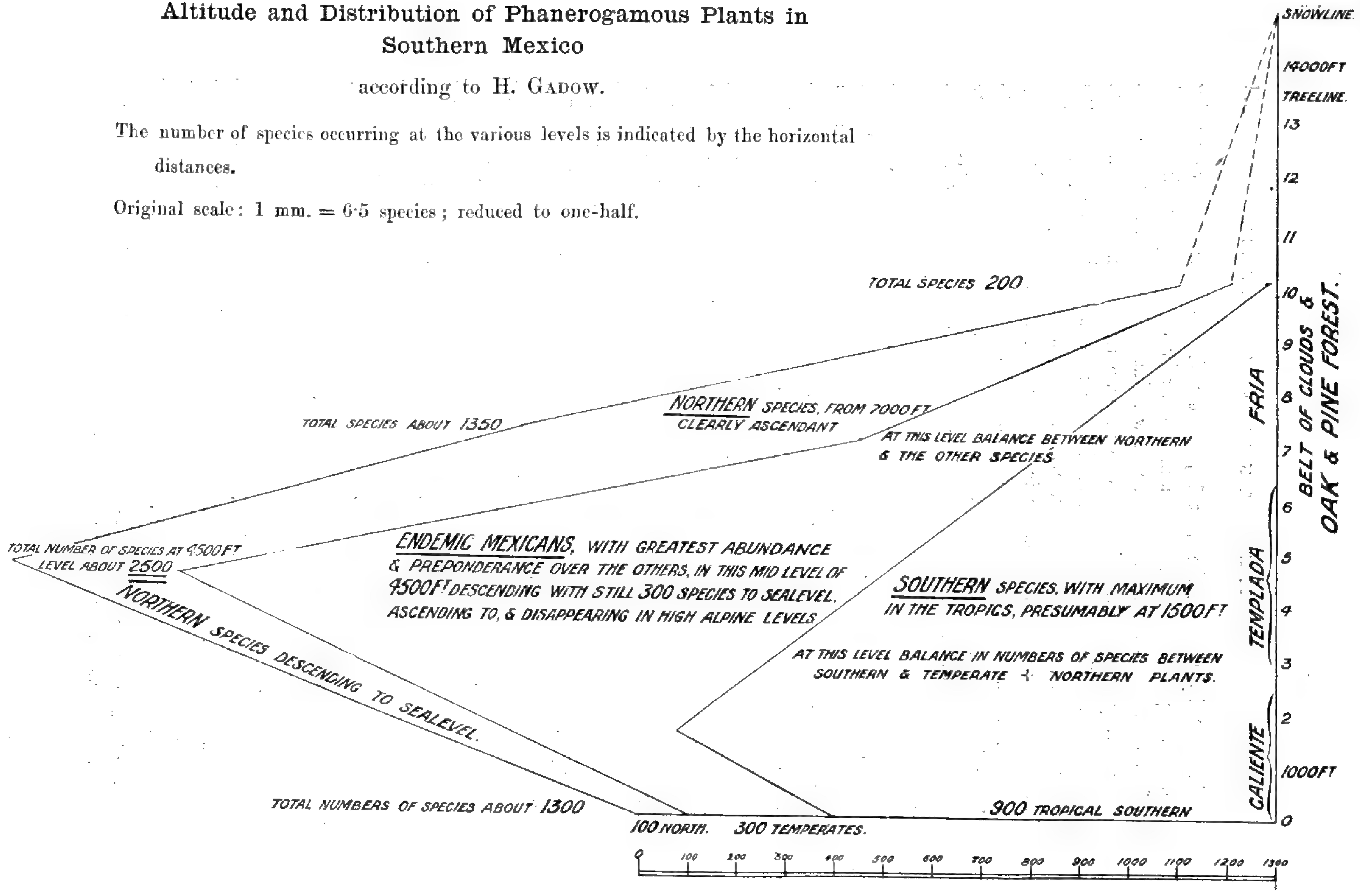
* It is important to note that the proportion differs but slightly whether we consider all the highest Mexican mountains, or restrict ourselves to Citlaltepetl.

Altitude and Distribution of Phanerogamous Plants in Southern Mexico

according to H. Gadow.

The number of species occurring at the various levels is indicated by the horizontal distances.

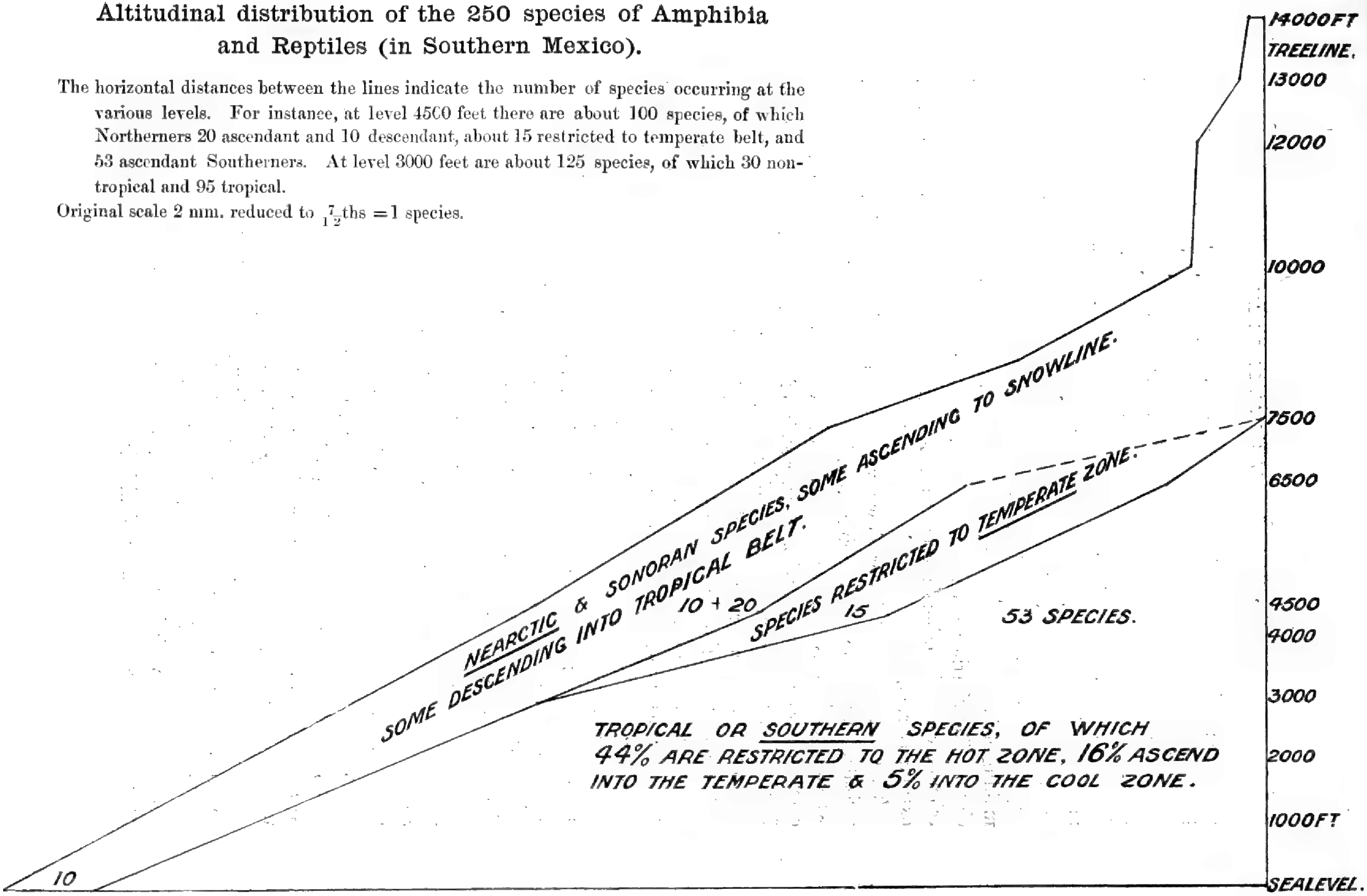
Original scale: 1 mm. = 6·5 species; reduced to one-half.



Altitudinal distribution of the 250 species of Amphibia and Reptiles (in Southern Mexico).

The horizontal distances between the lines indicate the number of species occurring at the various levels. For instance, at level 4500 feet there are about 100 species, of which Northerners 20 ascendant and 10 descendant, about 15 restricted to temperate belt, and 53 ascendant Southerners. At level 3000 feet are about 125 species, of which 30 non-tropical and 95 tropical.

Original scale 2 mm. reduced to $\frac{7}{12}$ths = 1 species.



as barren, whilst the south and east appear luxuriant. Then there is the impressionist bias of the leading features to contend with. We are impressed, for instance, at Xometla (south-east side of Citlaltepetl, 8500 feet) by the forest composed of Pines, Oak, *Arbutus*, and Alder ; they are the dominant feature, truly characteristic of that level, but they do not make up the majority of the species, which being smaller, although much more numerous, are far less impressive. But when we gather during an hour's ramble at haphazard an armful of plants, even if with the unscientific intention of making a bouquet of flowers, then the true state of affairs soon becomes clear. The Northerners are comparatively easy to sort out, they being old friends, while the others are endemic Mexicans, and in such the country is extremely rich.

They increase the lower down we go. At such a delightful level as Orizaba, Oaxaca, or Chilpancingo, *i.e.* between 4000 and 5000 feet elevation, whence high levels or a deep and wide valley can be reached by a few hours' excursion, we are struck with another state of affairs. The Northerners are few and far between, no longer obtrusive, nearly every plant is new to us ; but the plants after an hour's climb higher up give a very different impression from those which we meet at the bottom of the valley. The latter kinds, in looks and behaviour, make up a *tout ensemble* which we recognise as typical of the Tierra caliente, even if we have but slight experience of the tropics. Indeed, it is surprising what a change a thousand feet up or down can imply, not everywhere, but at the right level, and such a level is that mysterious border-land between what the natives call the Tierra caliente and the Tierra templada. Not much happens when safely within the Tierra templada, whether we are at 4000, 5000, or 6000 feet, but the changes are truly surprising which meet the traveller who crosses the ranges of hills, themselves only a few thousand feet high, which run parallel with the coast of Guerrero. There, at the bottom of the valleys, for instance on the Rio Omitlan, we are in the unmitigated tropics with nothing whatever to remind us of Northern influence; but one thousand feet higher, on the ridge, we are amongst Oaks and Pines and the tropical life is gone, although there, at 17° N., we are at a level of less than 2000 feet above the sea. We descend within an hour on the other side, to meet the same river winding its way through the full glory of the tropics.

It is one of the great attractions, and a circumstance which makes Mexico so valuable for the study of altitudinal distribution, that there we can get so easily into and out of the tropics. This is the case, first because the country is so extremely varied in its structure, secondly because most of it lies just upon the border-line of the tropical belt of the world.

But to return to our diagram. The area of the Southern species, and the long strip of the Northern species according to the plan adopted for the plotting out, enclose of necessity a large odd-shaped area which of course is not a vacuum. It represents the endemic temperate species of which we know how many extend into the alpine region, and of which many more grow down into the hot lands. It does not matter much whether we allow 200 or 600 species for this base ; nor does it matter whether we increase the absolute total number from 2500 to 4000 and refer it either to the 3500 or to the 5000 feet level. The general shape of the diagram with its three areas will remain essentially the same ; in other words, the broad principle expressed by it is correct. The shape of the diagram is odd, bulging out as it does at the 4500 feet level; but this very odd shape is another great point in its favour of being correct, since it graphically represents the respective areas of the hot, temperate, and cold regions of the country. A great portion of Mexico is high plateau with a mean elevation of perhaps 5000 feet, fringed east, south, and west by high Sierras, whilst the hot country, although formed by extensive coast-lands, is of comparatively small extent. But the southern portion of Mexico is much intersected by mountain-ranges and by deep depressions ; for instance, the large Balsas basin extends so far inland that it is exceedingly difficult to apportion the various areas, especially if we remember that much of the country is but imperfectly surveyed.

The following calculations can therefore be approximate only. Reckoning the country between 21° N. and the Isthmus to contain 185,000 square miles, I have apportioned 75,000 square miles to the Tierra caliente, 85,000 to the Tierra templada, and 25,000 square miles to the Tierra fria or to what lies above 7000 feet elevation. What lies above 10,000 feet can amount at most to a few hundred square miles.

The quotient of the areal number of square miles, divided by the number of species occurring, I call the *areal density of species.*

Thus we have :—

	Area in square miles.	Number of species.	Areal density, *i.e.*, an average of – sq. miles to every species.
Tierra caliente	75,000	1600	47
Tierra templada ...	85,000	2500	34
Tierra fria	25,000	1300	19

The result is somewhat surprising : the areal density of species increases steadily from the tropical belt upwards ! That of the tropics compared with

that of the temperate zone is almost exactly like 2 to 3 ; tropics compared with the cool zone like 1 to $2\frac{1}{2}$. If the temperate zone be taken as the normal condition, then the hot zone with its 75,000 square miles should have 2200 species instead of the assumed 1600, and the cool zone with 25,000 square miles should possess only 730 instead of 1300 species—*i. e.*, the cool zone has twice as many as expected ; and this is the case because most of the 1300 cool zone species have got up there so easily from the temperate base.

It would be ridiculous to conclude from the above Table that the Tierra fria is more favourable for plants, as regards number of species, than the Tierra caliente.

It seems a paradox that the areal density should increase from the tropical belt upwards. But the underlying principle, or solution, appears clear if we remember that on a very small area—say that of 10,000 feet elevation—with 200 species, the areal density would be enormous, perhaps averaging one species for every square mile, since in such places the species, although few, are crowded as if they were on refuge islands. If the area of the Tierra fria were three times as large as it is, equal to that of the tropical belt, there would probably be still not more than 1300 species, *i. e.* with an areal density of $19 \times 3 = 57$, *i. e.* much smaller than that of the tropical belt.

But the fact remains that the Tierra templada of Southern Mexico is richer than the tropical belt, probably for the following reasons. The upper limit of the Tierra caliente is generally assumed to lie at 3000 feet elevation ; undoubtedly this is not enough on the moist Atlantic side, but rather too much on the much drier Pacific slope. The belt of the Tierra templada, in this paper from 3000 to 7000 feet, comprises 33 per cent. more in vertical extent, and it comprises, moreover, in its larger area the most varied features, more varied and juxtaposed than exist in the other regions, from sweltering tropical rain-forests to vast arid tablelands. All the mountain-ranges of middle height lie in the Tierra templada, with their mysterious cloud-belt (not to be confounded with the cloud-belt which reaches from 7000 to 10,000 feet elevation on the giant mountains). Innumerable brooks exist in the Tierra templada before they combine into larger and therefore less varied rivers ; there are deep depressions in the Central Plateau with a semi-tropical climate, and also high wind-swept plateaus exposed to excessive heat in the summer days and to frost in the winter.

In short, the great variety of environmental conditions is responsible for the richness of the flora of this intermediate belt, the most delightful and prettiest of all Mexico.

It is therefore all the more interesting that this obviously reasonable

conclusion does not at all apply to the distribution of Amphibia and Reptiles, two groups which I have submitted to a detailed scrutiny *.

Tierra caliente	with 173 species.	Areal density	434	square miles.
Tierra templada	,, 100	,,	,, ,,	850	,, ,,
Tierra fria	,, 86	,,	,, ,,	290	,, ,,
Above 10,000 ft.	,, 10	,,	,, ,,	20	,, ,,

The total number of species in Southern Mexico is 250.

The actual number of species decreases from the tropics to the higher levels, just as we might expect; and the fewer species of the cool regions, just over half of those in the tropics, being condensed upon one-third of space, show naturally a much larger areal density. This is also not surprising, and it agrees with the plants. But the temperate belt possesses only 100 species; it is therefore comparatively by far the poorest of the three zones. I have been able to sift the total of 250 species into two categories.

I. *Southern or hot-country species.*	
Restricted to hot countries	44 per cent.
Ascending into temperate countries ...	16 ,,
Ascending into cool zone	5 ,,
II. *Northern or cool-country species.*	
Restricted to cool or cold zone	17 per cent.
Descending into temperate zone	8 ,,
Descending into hot countries	4 ,,
	94

The remaining 6 per cent.,—or, allowing for the difficulty of sorting intermediate species, at most 10 per cent.,—are species which seem to be restricted to the temperate belt. This surprisingly small number—only about 15 to 20 species—does not represent the Sonoran or truly endemic stock, but is for the most part composed of Southern ascendants or Northern descendants, which, so to speak, have stuck at this level and there have been modified into the respective species.

* The "Distribution of Mexican Amphibians and Reptiles," Proc. Zool. Soc. 1905, ii. pp. 191–244 (with tabulated lists and 6 diagrams to illustrate the contours of Mexico at different geological ages).

Mexico, although genetically part of the North American continent, has received its present fauna from both North and South America. The Northern fauna, which includes the Sonoran, and therefore what may be called the endemic Mexican stock, is the oldest arrival and its species belong now mostly to the cool and cold zone: the fauna of the plateaus is made up essentially of those Northerners which have spread, although thinly, over the elevated plains; some have remained in the temperate zone and a few have passed into the tropics. The Southern fauna has surged northwards through the Tierra caliente, both east and west of the plateau. This plateau as such presents a most effective barrier to the Southerners, few of them having to a small extent spread on to it, whilst some Southern species have succeeded in reaching greater elevations on those mountains which slope into the tropics. Lastly, those few species—about 15 to 20—which are restricted to the temperate zone and yet are not ancient endemics, show that, for Reptiles and Amphibia, the temperate belt is rather no-man's land than the happy medium favourable to the majority.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—IX. ALGÆ.

By R. J. HARVEY GIBSON, M.A., F.L.S., Professor of Botany, University of Liverpool.

[Read 5th December, 1907.]

[Reprinted from the Journal, Zoology, Vol. XXXI. pp. 76–80.]

THE following notes are the result of an examination of a small collection of Marine Algæ made by Mr. Crossland during 1904 and 1905, while engaged in investigations on the Sudan Marine Fauna, under the direction of Professor W. A. Herdman, F.R.S. Professor Herdman has handed me the collection for identification and report.

The plants were collected chiefly in the neighbourhood of Suakim and Trinkitat, and include 35 species, of which 12 belong to the Chlorophyceæ, 12 to the Phæophyceæ, and 11 to the Rhodophyceæ. In addition, 4 species of marine or brackish-water Phanerogams occur among the Algæ, and are given in an Appendix.

I am greatly indebted to Dr. M. Foslie, of Trondhjem, Dr. Reinhold, of Itzehoe, and to Mrs. Gepp for aid in identification of some of the calcareous and other forms both among the Rhodophyceæ and Chlorophyceæ, and also to the officials of the Cryptogamic Department of the Natural History Museum for aid rendered to me during a brief visit to the Museum for the purpose of identifying some of the more critical forms.

In addition to records of Algæ of the Indian Ocean and East Africa in more general works such as those of Agardh, Engler, Harvey & Sonder, &c., the following papers, dealing more especially with the forms occurring in the Red Sea and its immediate vicinity, have been consulted :—

ZANARDINI : "Plantarum in Mari Rubro hucusque collectarum enumeratio" (Mem. dell' I. R. Ist. Veneto, 1858).

PICCONE : "Contribuzioni all' Algologia Eritrea" (Nuov. Giorn. Bot. Ital. 1883).

HAUCK : "Ueber einige von J. M. Hildebrandt in Rothen Meere und in Indischen Ocean gesammelte Algen" (Hedwigia, 1886–89).

CHLOROPHYCEÆ.

1. CAULERPA RACEMOSA, *J. Ag.*, var. UVIFERA, *J. Ag.*; *Weber van Bosse, Monographie des Caulerpes* (*Ann. Jard. Buitenz.* 1898, p. 362).

This variety was dredged in 2–3 fathoms off Suez. It is recorded from

the Red Sea by Agardh, from Suez by Zanardini, and from the Somaliland Coast by Piccone.

2. Caulerpa peltata, *Lamx.*, f. typica; *Weber van Bosse, in Ann. Jard. Buitenz.* 1898, p. 375.

Collected on coral-reefs at Khor Dongola, Suez. Recorded by Zanardini, under the name of *C. chemnitzia*, var. *peltata*. It is not recorded by Piccone.

3. Halimeda incrassata, *Lamx.*, f. monilis, *E. S. Bart.*; *E. S. Barton, Genus* Halimeda, *Monogr.* lx. *of the Siboga Expedition*, 1889–1900.

Dredged at 2–3 fathoms at anchorage off Suez. Recorded by Zanardini, under the name of *H. monile*, from Suez, Akaba, and Kosseir.

4. Halimeda Opuntia, *Lamx.*, f. triloba, *Bart.*

Collected in shallows in Suakim Harbour.

5. Halimeda Opuntia, *Lamx.*

The plant here referred to seems intermediate in character between the f. *typica* and f. *cordata* of Barton's Monograph. This identification is on the authority of Dr. Reinhold.

6. Avrainvillea lacerata, *J. Ag.*

Suez Bay. Recorded from the same locality by Zanardini, under the name of *Chloroplegma sordidum*.

7. Avrainvillea papuana, *G. Murr. et Boodle.*

Suakim. This is a Malayan and Indian Ocean species, not recorded in any of the Red Sea lists above referred to.

8. Udotea argentea, *Zan.*

Mud-flats in Suez Bay. Recorded and figured by Zanardini as a new species. The present plant agrees in all respects with Zanardini's figure and description, as was pointed out to me by Mrs. Gepp.

9. Dictosphæria favulosa, *Decne.*

This form occurred along with sponges forming large patches on the sands at Khor Dongola. It is recorded as *Valonia favulosa*, Ag., from the Red Sea by Zanardini and by Piccone.

10. Codium tomentosum, *Kütz.*

One small and somewhat mangled plant was found attached to *Lithophyllum affine* (34). It was unmistakably, however, *C. tomentosum*, which has been recorded by several authors from the Red Sea.

11. Bryopsis plumosa, *Kütz.*
Suakim and Trinkitat.

12. Enteromorpha compressa, *Grev*
Suez Bay and Suakim.

PHÆOPHYCEÆ.

13. Sargassum dentifolium, *J. Ag.*; *J. G. Agardh, Spec. Sarg. Austr.* p. 101.

Dredged from Trinkitat Harbour. One of the most common *Sargassa* in the Red Sea. Recorded both by Zanardini and Piccone from Suez, Akaba, Tor, &c.

14. Sargassum latifolium, *J. Ag.*; *J. G. Agardh, l. c.* p. 103.

Dredged from 9 fathoms in Suez Bay. Recorded by Zanardini from the same locality. Hauck records a var. *zanzibarica* from the Somaliland Coast, but the present plant agrees more closely with the type itself.

15. Sargassum crispum, *Forsk.*

Suez Bay. Recorded also by Zanardini from the same locality.

16. Sargassum subrepandum, *J. Ag.*

Suez Bay. Trinkitat.

17. Cystoseira Myrica, *J. Ag.*

Several fragments referable to this species occurred in the collections. The species is described by Zanardini as "in mari rubro vulgatissima."

18. Hydroclathrus cancellatus, *Bory.*

Dredged from 10–12 fathoms at Khor Sinab. Recorded by Zanardini from Suez, Akaba, and Tor.

19. Padina pavonia, *J. Ag.*

Suakim, Suez Bay, and one young plant from Trinkitat.

20. Zonaria Schimperi, *Kütz.*

Suez Bay. I am a little doubtful of this identification as the plant is a young one, but it agrees with the description given by Zanardini, who records it from the same locality.

2 I 2

21. Dictyota dichotoma, *J. Ag.*
Tella Tella Kebira.

22. Sphacelaria rigida, *Kütz.*
An epiphyte on several *Sargassa.*

23. Ectocarpus siliculosus, *J. Ag.*
Suez Bay, Suakim.

24. Castagnea virescens, *Thur.*
Suez Bay. Suakim.

RHODOPHYCEÆ.

25. Laurencia pinnatifida, *J. Ag.*
Suez Bay. Recorded by Portier from Hodeida.

26. Laurencia divaricata, *J. Ag.*
Suez Bay. Recorded by Zanardini from Suez, and by Hauck from Madagascar and the Somaliland Coast.

27. Laurencia papillosa, *Grev.*
Suakim. Recorded also by Piccone from Massaua and the Assab Archipelago and by Hauck from the Somaliland Coast, and by Zanardini from Suez, Tor, Djedda, &c.

28. Gelidium rigidum, *Grev.*
Trinkitat. Recorded from the Red Sea by Zanardini, from Massaua and the Assab Archipelago by Piccone, and by Hauck from the Zanzibar Coast.

29. Gelidium corneum, *Kütz.*
A form of this species occurs among the collection obtained at Trinkitat, which appears to be near Piccone's var. *ambiguum.*

30. Polyzonia jungermannioides, *J. Ag.*
On *Sargassum dentifolium*, but fragmentary.

31. Hypnæa Valentiæ, *J. Ag.*
Trinkitat and Suez Bay.

32. Spyridia filamentosa, *J. Ag.*
Suez Bay. Recorded also by Zanardini from the same locality, and also from Akaba and Kosseir.

33. Corallina tenella, *Kütz.*

Suakim. This plant was identified for me by Dr. Reinhold.

34. Lithophyllum affine, *Fosl.*

Suakim. Dr. Foslie informs me that this species is probably only a variety of *L. Kaiserii*, Heydr., or both may be varieties of the Pacific species *L. pallescens*, Fosl.

35. Goniolithon myriacarpon, *Fosl.*

Suakim. According to Dr. Foslie this is a variable species, and he identified the plant I sent him with a query.

APPENDIX.

The following two species of Potamogetonaceæ were also present in the collection, viz., *Cymodocea nodosa*, Aschers., and *Halophila stipulacea*, Aschers.; and also *Najas marina*, Linn. (Naiadaceæ), from Suez mud-flats. Fragments of *Salicornia fruticosa*, Linn., were also present in the same gatherings.

Notes on some Wild Forms and Species of Tuber-bearing Solanums.

By Arthur W. Sutton, F.L.S.

(Plates 38–49.)

[Read 20th February, 1908.]

In 1883, Mr. J. G. Baker, F.R.S., F.L.S., at the suggestion of the late Lord Cathcart, made a study of the various species of tuber-bearing Solanums, the results of which were embodied in a paper presented to the Society on January 17th, 1884*.

Lord Cathcart was interested chiefly in the discovery of some wild species of tuber-bearing *Solanum* which could be utilized for crossing with the commonly cultivated potato, in the hope of obtaining new forms capable of resisting the attacks of the potato-disease fungus, *Phytophthora infestans.*

It was concluded that *Solanum Maglia* of Schlechtendal, generally known as Darwin's potato, afforded the best prospect of success in the direction, since this species does not appear to suffer from the disease in its indigenous habitat in the low-lying swampy soil of the Chonos Archipelago, whereas the ordinary potato is practically destroyed by the fungus on wet soils in damp seasons.

On August 6th, 1886, I obtained tubers of *Solanum Maglia* from a plant growing in the gardens at Kew, the tubers being dug up in the presence of Mr. Baker and myself.

(Plate **38**. Flowers, foliage, &c., of *Solanum Maglia*, Schlecht., drawn from living specimen grown at Reading.)—This species, so far as my experience goes, does not produce fertile seeds when pollinated with its own pollen: although it blooms very freely, the flowers drop off prematurely. Many hundreds of attempts were made to fertilize *Maglia* flowers with the pollen from cultivated potatoes, but in one instance only was a hybrid seedling obtained, the latter being the produce of a cross made in July 1887.

The hybrid, which has been cultivated continuously during the past 20 years has smooth tubers nearly white in skin (the tubers of *Solanum Maglia* are a dull, dark purple colour), with leaflets more pointed than those of cultivated potatoes.

In addition to experiments with *Solanum Maglia*, crosses were attempted with *Solanum Jamesii*, but from none of these were seedlings obtained.

Resembling *Solanum Maglia* in its general refusal to set "seed" either when pollinated with its own pollen or with that from other species, is *Solanum Commersonii* of Dunal.

(Plate **39**. *Solanum Commersonii*, Dun., white-flowered form, foliage, flowers, &c.)—Two forms of this species are known; one bearing lilac

* See Journ. Linn. Soc., Bot. vol. xx. (1884) pp. 489–507.

flowers and corresponding both in this and in all other respects with Dunal's description, and the other very similar to it but bearing white flowers. In both forms the jessamine-like scent of the flowers is very noticeable. Of the violet-flowered form I have had very many tubers collected in a wild state in Uruguay, and Professor Archeavaleta of Montevideo assures me that there is no other form to be found in a wild state in Uruguay. There is, however, reason to think that the white-flowered variety was introduced into France from Uruguay by a Colonel Robido in the year 1895. Many attempted pollinations were made with both varieties, but only one weak seedling from each has been obtained.

In 1901 M. Labergerie, of Verrières, Vienne, stated that some of the tubers of *Solanum Commersonii* (white-flowering type), which had been given him in the spring of that year by Professor Heckel of Marseilles, had given rise to a new variety by "sporting" or bud variation. The supposed new plant was named by M. Labergerie "*Solanum Commersonii* 'Violet.'" (Plate **40**. "*Solanum Commersonii* 'Violet,'" Labergerie, foliage, flowers, &c.)

Much controversy has arisen in regard to it, since it differs entirely from *Solanum Commersonii* in the character of its tuber, foliage, flower, and habit of growth, as well as in the form and size of its pollen-grains. On account of the very close resemblance in all its morphological features to the variety of the cultivated potato known on the Continent as Paulsen's "Blue Giant" (Plate **41**. Paulsen's "Blue Giant" Potato, foliage, flowers, &c.), it has been concluded by most investigators who have grown the so-called "sport" and the latter variety side by side in the same soil, that a stray tuber of the "Blue Giant" must have found its way accidentally into the plantations of *Solanum Commersonii* in M. Labergerie's garden.

(Plate **42**. *Solanum Commersonii*, Dun., flowers, tubers, &c. Plate **43**. "*Solanum Commersonii* 'Violet,'" Labergerie, flowers, tubers, &c. Plate **44**. Paulsen's "Blue Giant" Potato, flowers, tubers, &c.)—On reference to Plate **39** it will be noticed that the seed-berries are distinctly cordiform in shape, much more so than is seen in any other tuber-bearing *Solanum*, the usual form of berry in the wild species being round or slightly oval, and in almost all the cultivated potatoes distinctly round. The pollen-grains shown on Plate **39** are entirely regular and elliptical in form. In both these respects true *Solanum Commersonii* differs greatly from the "sport" supposed to have been derived from it, as will be seen on reference to Plate **40**.

A comparison between Plates **42** and **43** will show not only the relative form and size of the tubers in *Solanum Commersonii* and in the presumed sport, but also the fact that the tubers of the former (see Plate **42**), as in the case of nearly all other wild species, are borne at the extremity of long underground stolons, whereas the tubers of the "sport," like all cultivated potatoes, are produced close to the base of the stem. A further comparison

between Plates **40** and **41** will show the complete similarity which exists between the pollen-grains of the supposed sport and Paulsen's "Blue Giant," and also between the seed-berries of these two. A comparison of the hairs of the tips of the petals on Plates **39**, **40**, and **41** is also suggestive. It will also be seen on comparing Plates **43** and **44**, that the tubers of the supposed sport and Paulsen's "Blue Giant" correspond in all respects.

Besides *Solanum Maglia* and *Solanum Commersonii*, I have had the following wild species under observation and experiment at Reading :—

1. Two distinct forms of *Solanum tuberosum* sent me by Mr. Stuart, of the Vermont Experiment Station, U.S.A. One of them, collected in Mexico, Mr. Stuart considered to be a practically unaltered ancestral form of *Solanum tuberosum*.

(Plate **45**. *Solanum tuberosum*, Linn., var.)—The chief points of interest in this plate are :—

(*a*) The regular and elliptical form of pollen-grains.

(*b*) The wheel-shaped corolla, in contrast with the star-shaped corolla of *Solanum Commersonii* (Plate **39**). This wheel-shaped corolla is also seen in *Solanum Maglia* (Plate **38**), in *Solanum etuberosum* (Plate **46**), and almost universally in the cultivated potatoes.

(*c*) The round form of the seed-berry, in contrast with the cordiform seed-berries of *Solanum Commersonii* (Plate **39**).

2. *Solanum polyadenium*, Greenman, also from Mr. Stuart. This species is one of the most distinct of all wild tuber-bearing Solanums with which I am acquainted, the leaves and stems being covered with a dense coat of hairs, and emitting a strong scent somewhat resembling that of Feverfew, *Pyrethrum Parthenium*, Sm.

3. *Solanum verrucosum*, Schlecht.

4. *Solanum tuberosum*, var. *boreale* (= *Solanum Fendleri*, A. Gray), from Arizona.

The latter was sent to me by the Rev. J. Aikman Paton, of Castle Kennedy, N.B.

5. *Solanum etuberosum*, Lindley. (Plate **46**.)

All the five last mentioned wild species, except *Solanum etuberosum*, flower freely, and produce fruits containing an abundance of seeds. The plants raised from seed of these wild species (excepting only *Solanum etuberosum*) exhibit no variation whatever from the parents or among themselves, even when the seeds are taken from plants allowed to flower in close proximity to

other species. Seedlings, however, of the commonly cultivated potatoes differ very widely from each other, those raised from the seed-berry or fruit generally exhibiting extensive variation in foliage, colour of tuber, and in habit of growth.

I find that the pollen-grains of all these wild species are of one particular shape, namely oval or elliptical, whereas the pollen-grains of all the cultivated potatoes which I have examined are very irregular in form and size, and possibly degenerate. This fact is clearly illustrated on Plate **49**.

One of the forms or species which has proved of great interest, and which on account of its remarkable exemption from disease may become of economic value, is *Solanum etuberosum*, Lindley. This name was given by Lindley in 1834 to a tuberless *Solanum*, which he states was obtained from Chile some years previously by the Horticultural Society. He described it as exceedingly like the ordinary potato, *Solanum tuberosum*, Linn., in all its characters, except that it possesses thickened rhizomes devoid of definite tubers, and the calyx and flower-stalks are smooth instead of hairy.

It may be remarked here that if Lindley's plant of *Solanum etuberosum* produced no tubers, it would have been difficult to propagate it except from seed; and judging by the behaviour of the plants I have experimented with, it is not likely that Lindley's plants reproduced themselves from seed, for two reasons: 1st, that seed-berries are very rarely formed, and 2nd, when formed the seedlings resulting therefrom differ so markedly from the parent stock. It may be suggested that the *Solanum etuberosum* when growing in the wild state, the tubers, of course, not being lifted from year to year and replanted, might produce tubers so small as to be mistaken for "thickened rhizomes devoid of definite tubers,"—or that possibly the plants which Lindley examined may not have been fully developed, in which case the tubers would not yet have been formed.

The examples of *Solanum etuberosum* which I possess came originally from the Botanic Gardens, Edinburgh, in March 1887, through Mr. Lindsay, and again from the same stock in 1897 from Dr. Bayley Balfour. They produced at first small tubers about the size of walnuts, and the calyces are hispid; in other respects the plants are similar to the type specimen described by Lindley.

Solanum etuberosum has been grown continuously for more than twenty years in the Trial Grounds at Reading. During that time no variation has occurred in the characters of the foliage or flowers of the plants. The tubers have also retained their original form and colour with the exception of an increase in size.

Up to 1906 the plants had never been seen to bear fruits, but in that year a single berry was found in the centre of the plantation and allowed to ripen. Whether this was the product of self-fertilization or the result of a cross with some other *Solanum* growing near, it is impossible to say.

The seeds taken from this fruit were sown, and during the past season (1907) twenty young plants were raised. None of these resemble the parent form very closely, but they exhibit the same variation that is met with among seedlings of the cultivated potato.

The tubers of the parent *Solanum etuberosum* are white in the skin and flesh, and after twenty years of garden culture average about $1\frac{1}{2}$ inches in diameter. Those of the seedlings, however, vary very much in size, some being already as large as cultivated potatoes: they are also very varied in colour of skin, some being white, others dark purple, pale blue, or rose white; one seedling has given tubers the flesh of which is deep purple and the skin almost black, characters which are met with in some of the cultivated varieties now growing in Chile.

The pollen-grains of the parent are elliptical like those of all wild species, and the seed-berries are round or slightly oval, but are covered somewhat closely with distinct white spots, in which they differ from the fruits of all other wild types.

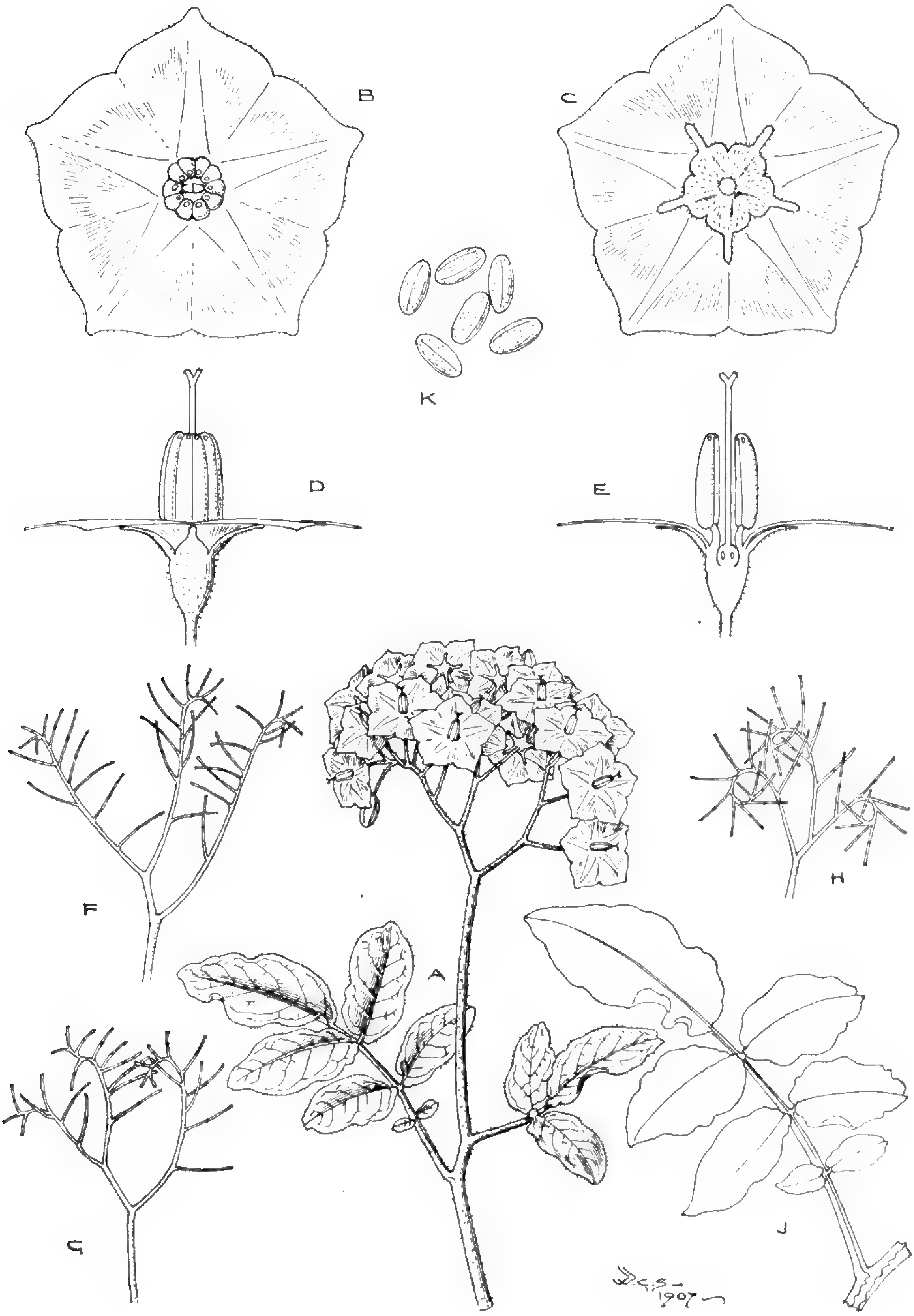
(Plate **47**. *Solanum etuberosum,* Lindl.—White-flowered seedling.) I was only able to examine the pollen-grains of one of the twenty seedlings above referred to, and that happened to be a plant bearing white flowers. In this case the pollen-grains were regular and elliptical, and entirely similar in form to those of the parent. The coming season I hope to examine more of the seedlings, to determine if the pollen-grains of any of them are irregular like those of the cultivated potatoes.

[P.S. (Sept. 1908).—In order to avoid any doubt as to the parentage of the seedlings above described, several different blooms of *Solanum etuberosum* were artificially self-pollinated under controlled conditions in 1907. Ripe fruits were obtained from several flowers. Seedlings raised from these in 1908 exhibit the same variability in character of foliage, and colour of the flowers as those obtained from the single berry collected in 1906, the male parent of which was uncertain, and they vary also in the form and colour of tuber.

Some of the plants raised from the same berry have white flowers, others lilac-coloured blooms.

The pollen-grains of the white-flowered plants of 1908, like the one white-flowering plant of 1907 alluded to above, are elliptical like those of the lilac-flowered parent, while those of the lilac-flowered seedling are irregular and polygonal in form, corresponding closely in these respects with pollen-grains of the cultivated potatoes. These are illustrated in Plate **49**, and on Plate **48** is figured one of the lilac-flowered seedlings raised by selfing flowers of *Solanum etuberosum* in 1907, with drawings of its irregular pollen-grains.

From the uniform character and shape of its pollen-grains, it would appear

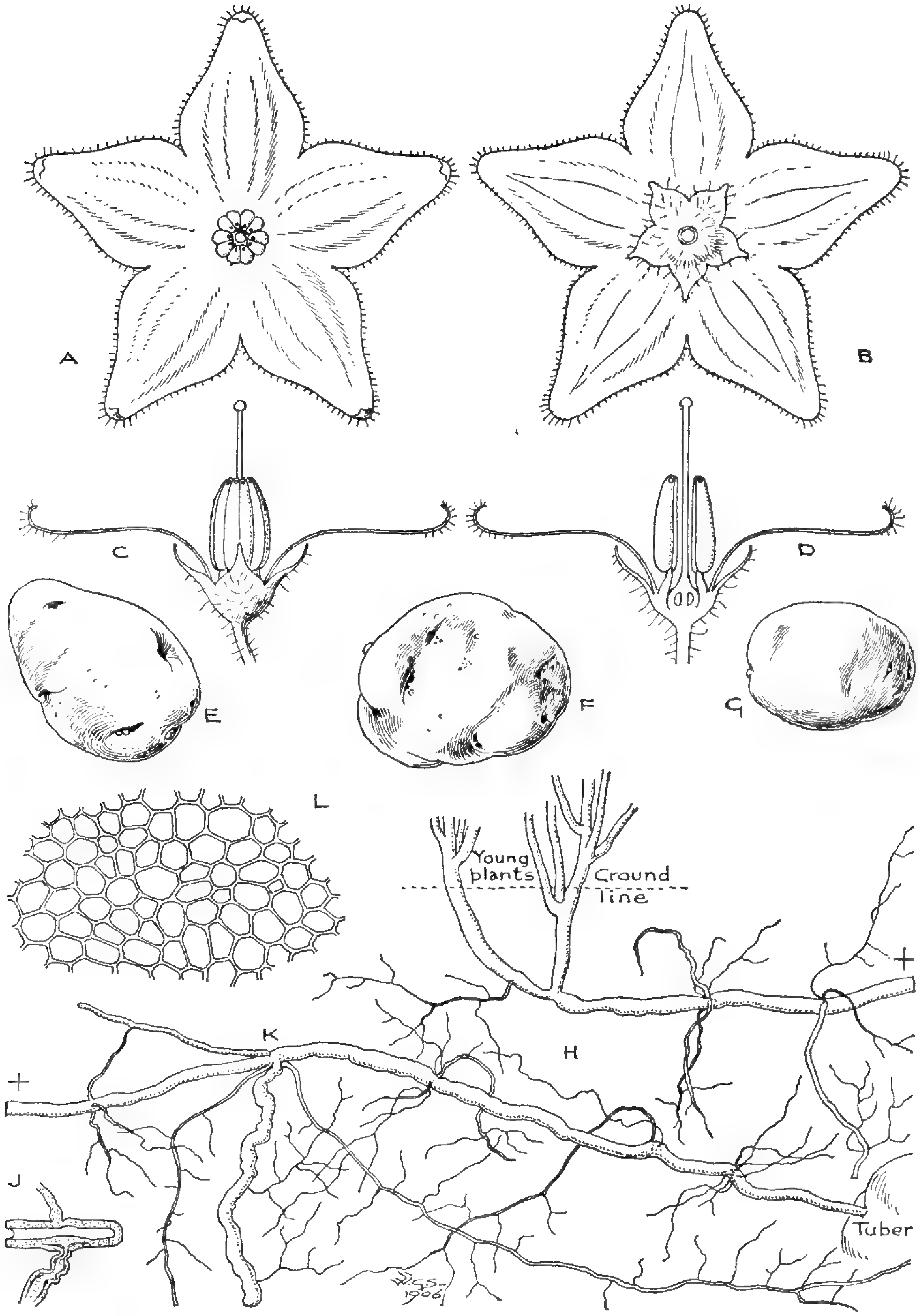


SOLANUM MAGLIA, Schlecht.

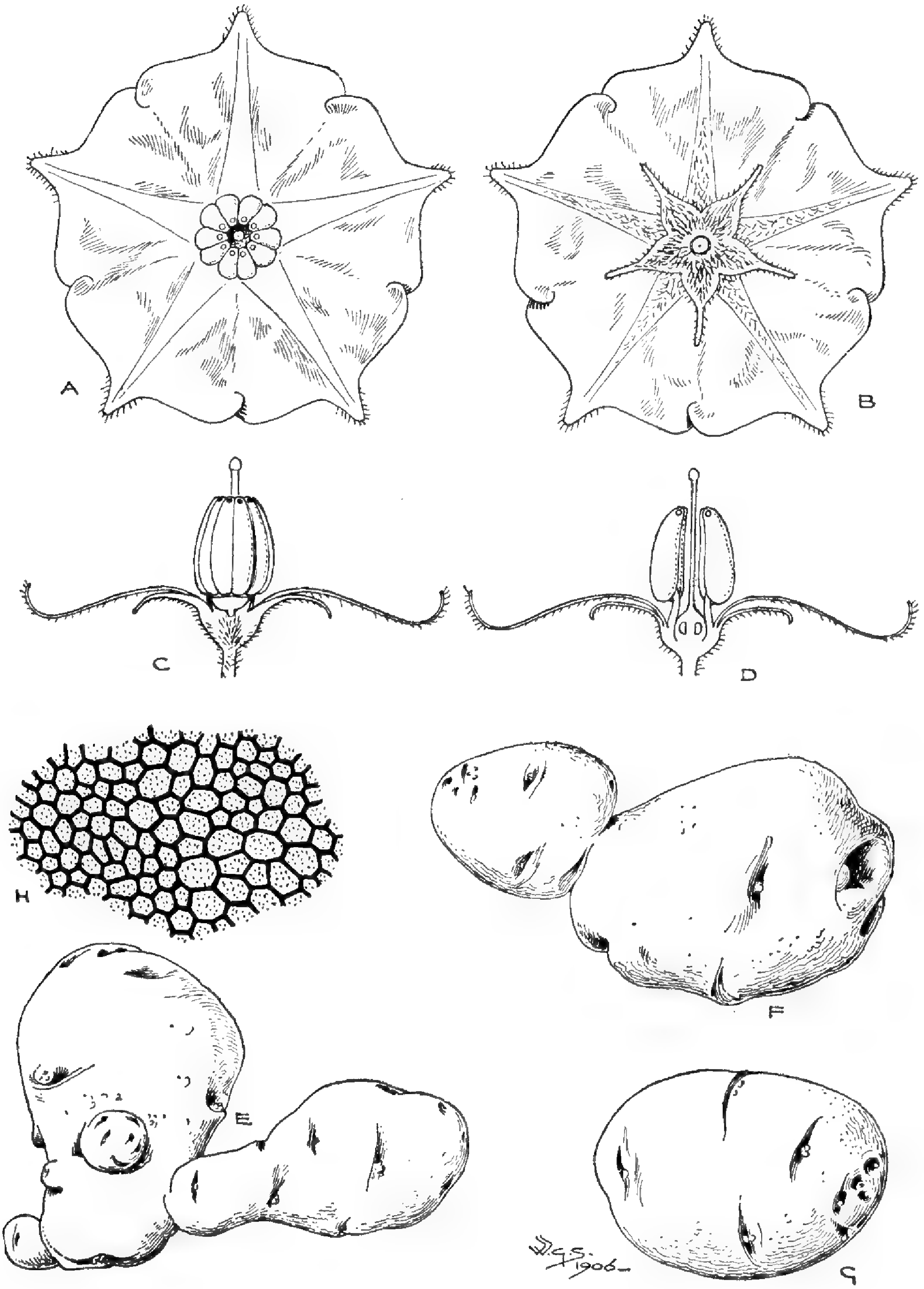
SOLANUM COMMERSONII, Dun. (White flowered form).

"SOLANUM COMMERSONII 'Violet'", Labergerie.

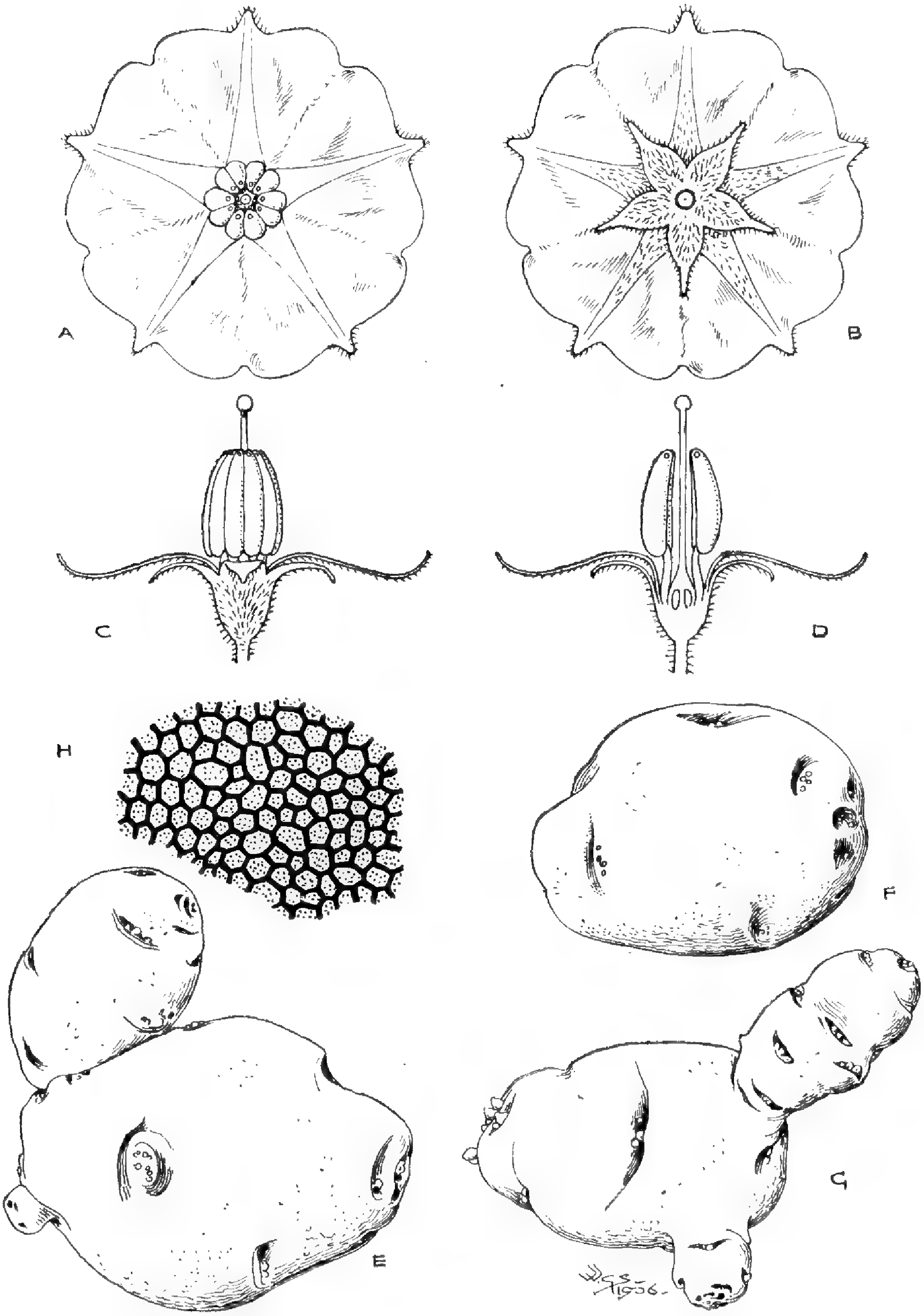
Paulsen's "Blue Giant" Potato.



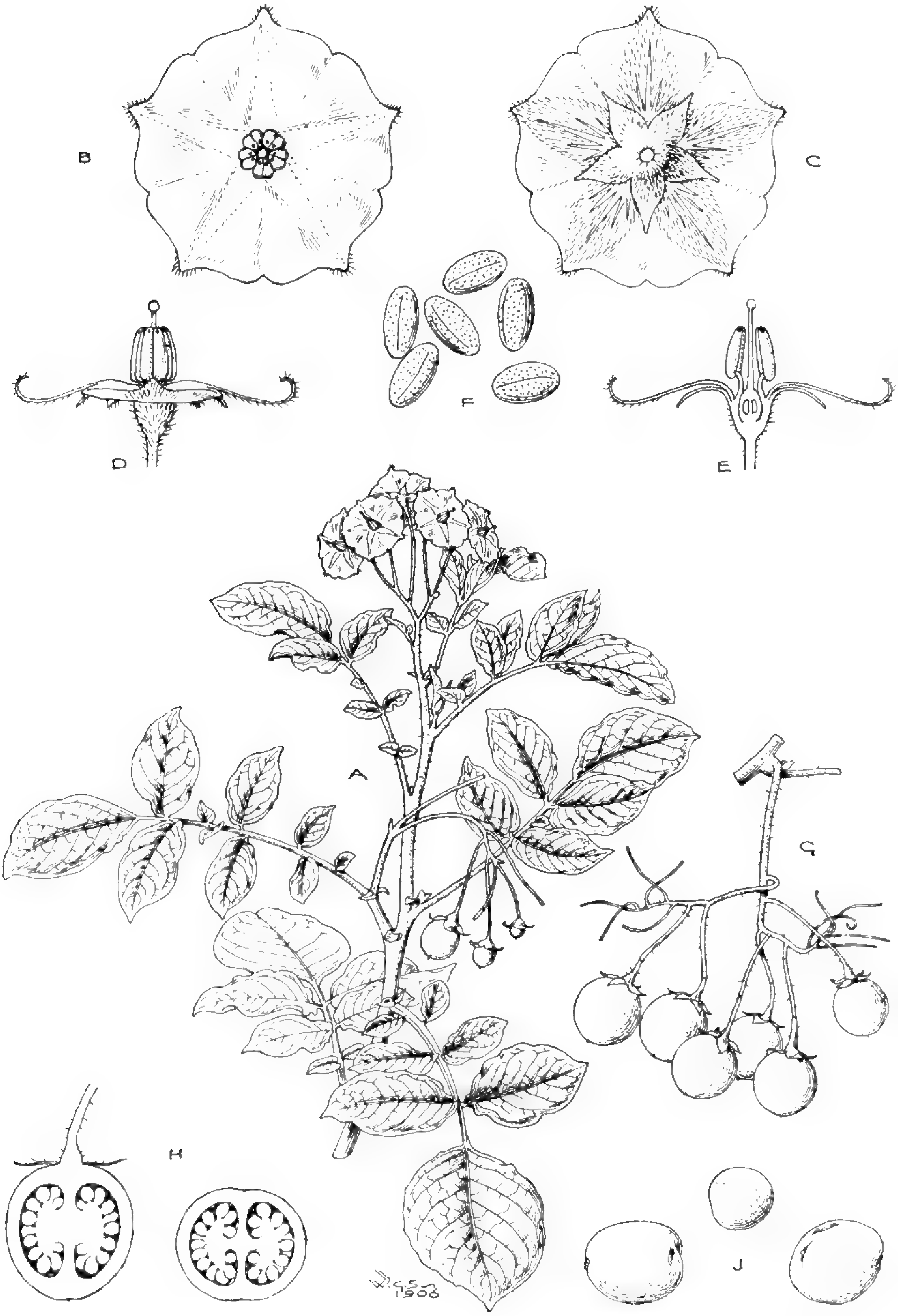
SOLANUM COMMERSONII, Dun. (White flowered form).



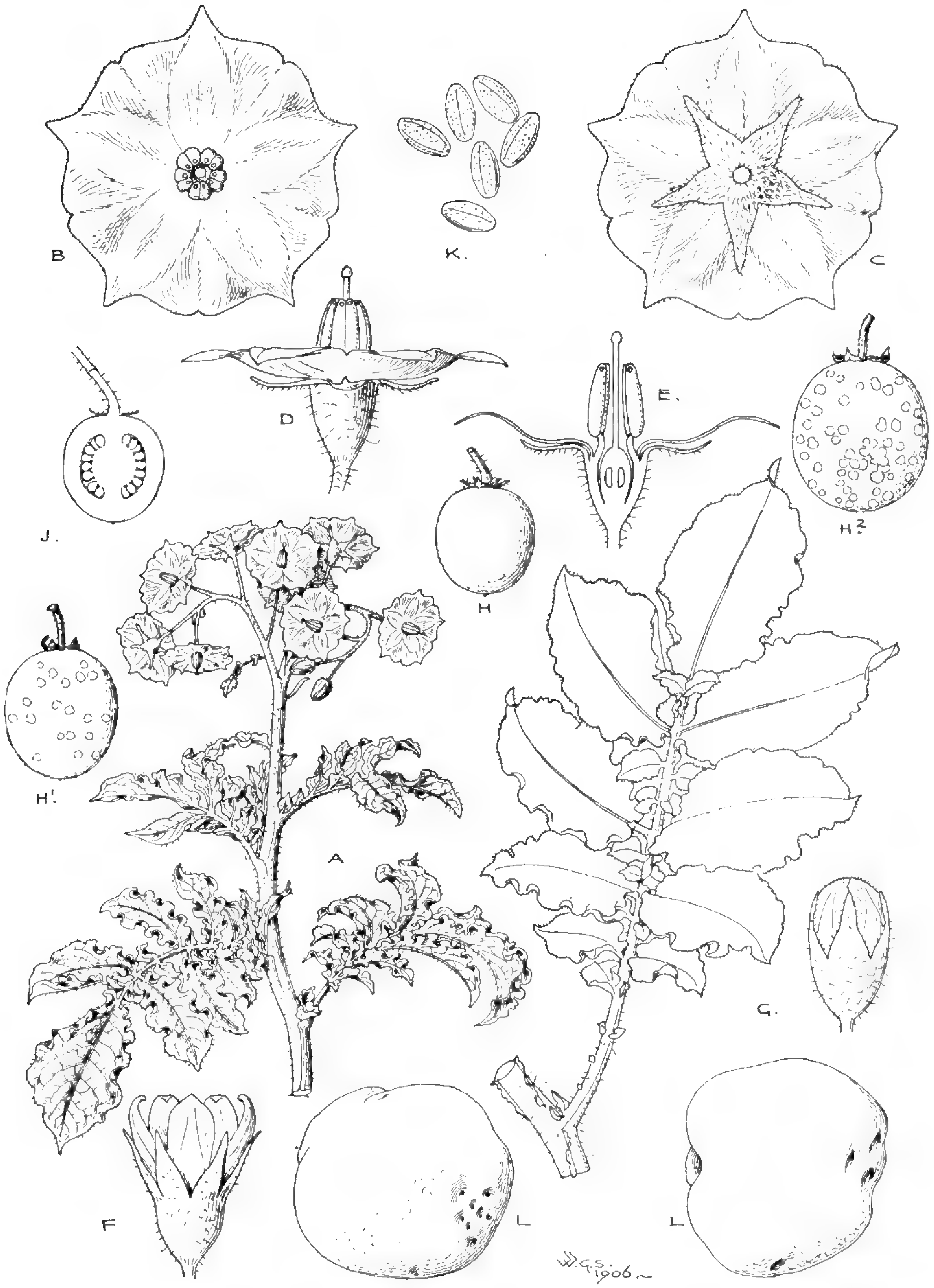
"SOLANUM COMMERSONII 'Violet'", Labergerie.



Paulsen's "Blue Giant" Potato.

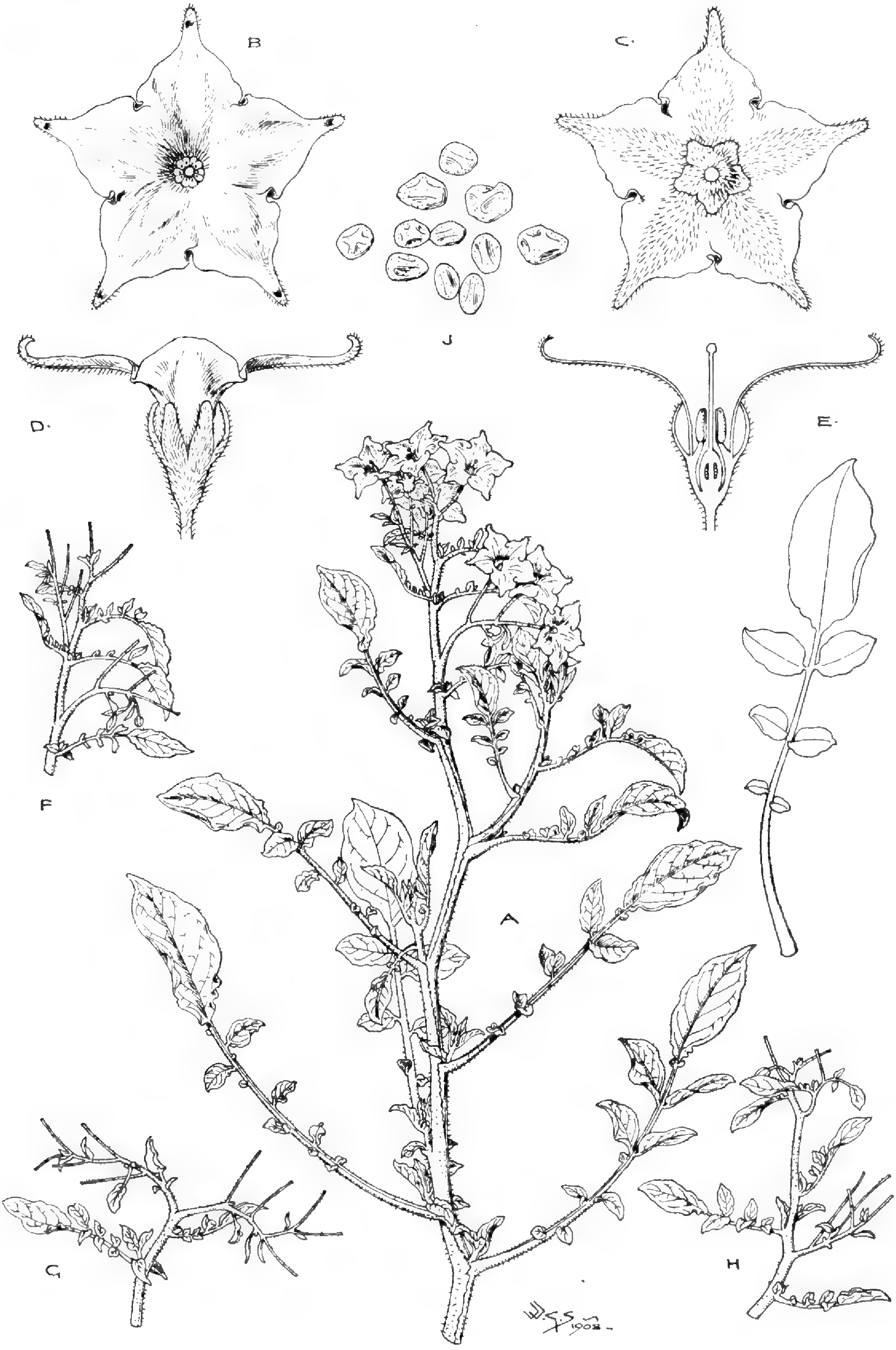


SOLANUM TUBEROSUM, Linn., var.

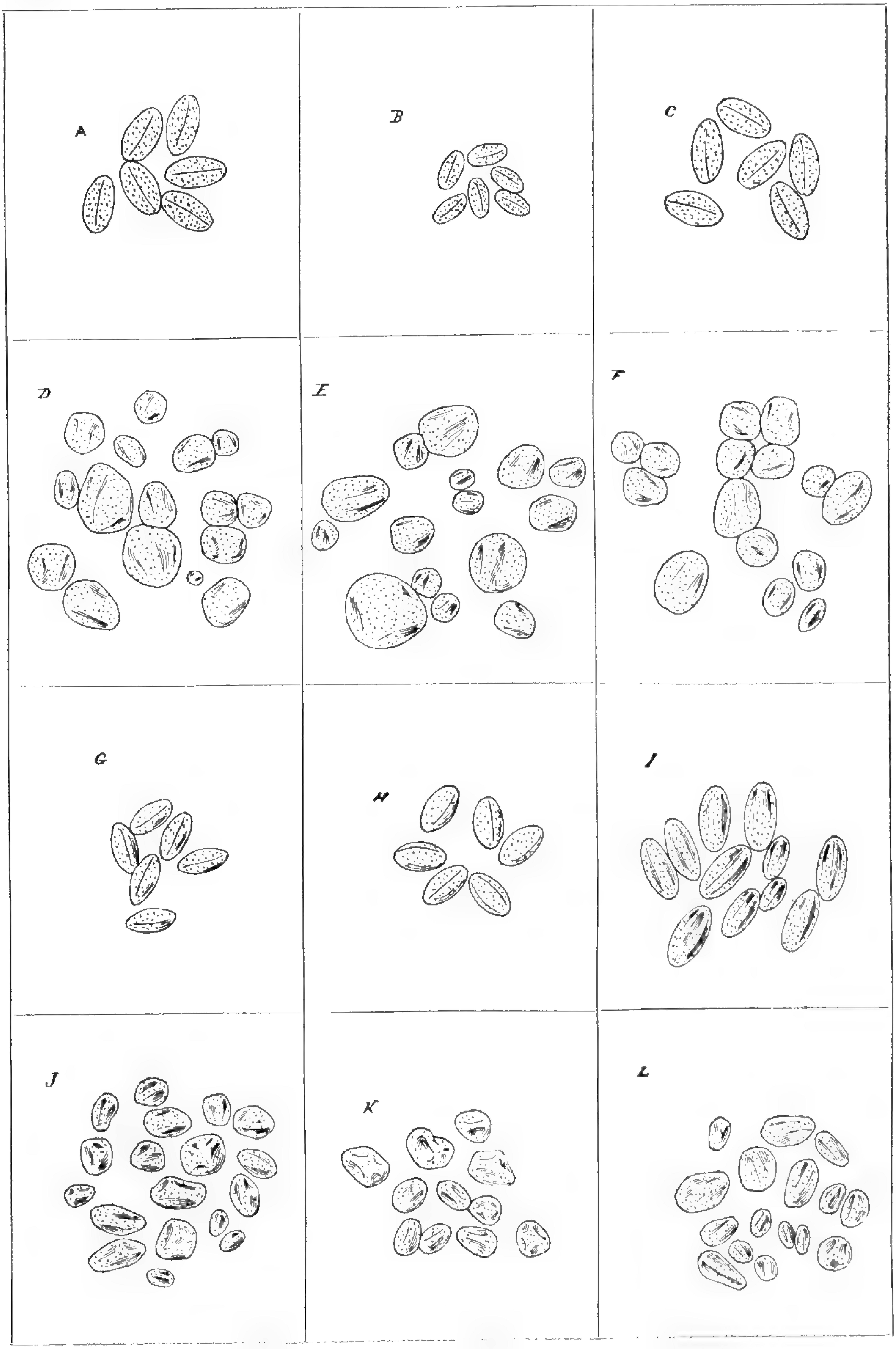


SOLANUM ETUBEROSUM, Lindl.

SOLANUM ETUBEROSUM, Lindl. (White flowered seedling.)



SOLANUM ETUBEROSUM, Lindl. (Lilac flowered seedling).



POLLEN OF VARIOUS SPECIES OF SOLANUM.

that *Solanum etuberosum* is a primitive specific form, since it agrees in this respect with admittedly wild species of tuber-bearing Solanums. Moreover, in the great variability of its seedlings it closely resembles the cultivated potato. These facts, I think, point to the conclusion that Lindley's *Solanum etuberosum* may probably be the parent form of the cultivated potato of to-day.]

ARTHUR W. SUTTON.

EXPLANATION OF THE PLATES.

The figures on the Plates were all drawn from specimens growing in the Reading Trial Grounds.

PLATE 38.

Solanum Maglia, Schlecht.

A. Inflorescence and upper leaves, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view × 2, showing cleft stigma.
E. Flower section, × 2, showing cleft stigma.
F, G, H. Cymes with flowers removed, ½.
J. Largest leaf on examples examined, ½.
K. Pollen, × 300.

PLATE 39.

Solanum Commersonii, Dun. (White-flowered form.)

A. Inflorescence and upper leaves, large lower leaf behind, ½.
B. Cymes with flowers removed, ½.
C. Flower-bud, × 2.
D. Hairs from tips of petals, × 50.
E. Hairs from limb of corolla, × 50.
F. Pollen, × 300.
G. Self-fertilized berries, ½.
H. Seed, × 2.
J. Cross-fertilized berries, ½.
K. Sections of do., ¼.
L. Seed, × 2.

PLATE 40.

"*Solanum Commersonii* 'Violet,'" Labergerie.

A. Inflorescence and upper leaves, large lower leaf behind, ½.
B. Cyme with flowers removed, ½.
C. Hairs from tips of petals, × 50.
D. Hairs from limb of corolla, × 50.
E. Pollen, × 300.
F. Berry, ½.
G. Section of berry, ¼.
H. Seed, × 2.

PLATE 41.

Paulsen's "Blue Giant" Potato.

A. Inflorescence and upper leaves, large lower leaf behind, ½.
B. Cyme with flowers removed, ½.
C. Hairs from tips of petals, × 50.
D. Hairs from limb of corolla, × 50.
E. Pollen, × 300.
F. Berry, ½.
G. Section of berry, ¼.
H. Seed, × 2.

PLATE 42.

Solanum Commersonii, Dun. (White-flowered form.)

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Flower section, × 2.
E, F, G. Tubers, $\frac{1}{2}$.
H. Stolon cut at ++ showing distance from plant at which tubers are produced, $\frac{1}{2}$.
J. Section of stolon at K, $\frac{1}{1}$.
K. Point of section shown at J.
L. External cells of tuber, × 60.

PLATE 43.

"*Solanum Commersonii* 'Violet'" Labergerie.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Section, × 2.
E, F, G. Tubers, $\frac{1}{2}$.
H. External cells of tuber, × 60.

PLATE 44.

Paulsen's "Blue Giant" Potato.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Section of flower, × 2.
E, F, G. Tubers, $\frac{1}{2}$.
H. External cells of tuber, × 60.

PLATE 45.

Solanum tuberosum, Linn., var.

A. Inflorescence and upper leaves, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Pollen, × 300.
G. Cyme with berries, $\frac{1}{2}$.
H. Berry, vertical and horizontal sections, $\frac{1}{1}$.
J. Tubers, $\frac{1}{2}$.

PLATE 46.

Solanum etuberosum, Lindl.

A. Inflorescence and upper leaves with large lower leaf, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view × 2.
E. Flower section, × 2.
F. Bud, × 2.
G. Bud, × 2.
H. Berry, $\frac{1}{1}$.
H^1., H^2. White-spotted berries, $\frac{1}{1}$.
J. Berry section, $\frac{1}{1}$.
K. Pollen, × 300.
LL. Tubers, $\frac{1}{2}$.

Plate 47.

Solanum etuberosum, Lindl. (White-flowered Seedling.)

A. Inflorescence and upper leaves, large lower leaf behind, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Cyme, with flowers removed, $\frac{1}{2}$.
G. Pollen, × 300.

Plate 48.

Solanum etuberosum, Lindl. (Lilac-flowered Seedling.)

A. Inflorescence and upper leaves, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F, G, H. Cymes with flowers removed, $\frac{1}{2}$.
J. Pollen, × 300.

Plate 49.

Pollen of various Species of *Solanum*.

A, B, C. Figures representing t.e pollen-grains of *Solanum verrucosum, Solanum polyadenium*, and *Solanum tuberosum* respectively, each × 300. Although varying somewhat in size, the form in each case is regular and elliptical, and is typical of the pollen-grains of all the wild types I have examined.

D, E, F. Representing the pollen-grains of the cultivated potatoes "Up to Date," "Main-crop," and "Discovery" respectively, each × 300. There is little if any difference in the size of these three groups of pollen-grains, and in each case the form is irregular and polygonal, and thus typical of the pollen of all the cultivated potatoes I have examined.

G. Pollen-grains of *Solanum etuberosum*, × 300.

H. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1906. The form of pollen-grains still remains regular and elliptical. × 300.

I. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1907. The form of pollen-grains still remains regular and elliptical. × 300.

J, K, L. Pollen-grains of three seedling plants raised from berries produced in 1907, each bearing lilac flowers. The form of pollen-grains in each case is irregular and polygonal, corresponding to that of the cultivated potatoes. × 300.

In each case all pollen-grains shown in I, J, K, and L, the flowers had been artificially selfed under controlled conditions.

The seedling plants which gave the pollen-grains shown in I and J were raised from the same seed-berry.

N.B.—The figures of pollen-grains on this Plate, and those also shown on previous Plates, were drawn when the pollen-grains were dry.

On a Method of Disintegrating Peat and other Deposits containing Fossil Seeds. By ELEANOR M. REID, B.Sc. (Communicated by CLEMENT REID, F.R.S., F.L.S.)

[Read 6th February, 1908.]

AT the present time much interest is being taken in the investigation of deposits of peat, and many inquiries reach us as to the methods of disintegrating these deposits so that an examination may be made of the fossils contained in them. It may be well, therefore, to describe a very simple method which I have used of late with great success. By it the examination of peat is rendered as easy as that of loam, and can be accomplished with the same degree of thoroughness.

The method is an extension of one used for many years by Mr. Reid and myself, though without any striking results. We have long been accustomed to boil peats with a small quantity of carbonate of soda, as we have found that this assisted the process of disintegration. But even so, we have always regarded peat as one of the most difficult and intractable of the materials with which we have to deal. The change in method which I have employed lately with such satisfactory results, is to use a very large, instead of a small, percentage of carbonate of soda. I have used dehydrated soda, sold commercially at a very cheap rate as concentrated soda. This is stronger, and therefore less bulky and more convenient, than common washing soda.

The method was first tried last summer on three samples of an ancient highly-compressed peat, sent from Hornsea and Bielsbeck respectively, by the Committee of the British Association "appointed to investigate the Fossiliferous Drift deposits at Kirmington, Lincolnshire, and at various localities in the East Riding of Yorkshire." The samples were sent as being most difficult, if not impossible, to deal with. Similar samples had been treated with dilute soda solution, but with no success, and the Secretary, Mr. Stather, writes of the Bielsbeck peat: "The material will *not* break down, in fact it seems tougher at end of process than at the beginning." He adds that the Hornsea peat is "equally intractable." It was evident that strong measures would be necessary, so I boiled each sample with a large quantity of dehydrated soda, perhaps a third or more of its bulk in each case. To my surprise, when I came to wash them, I found that instead of being difficult to break up, I had never before experienced anything like such ease in dealing with peat. A very little crumbling with the fingers loosened the fibre so that the matrix could easily be washed away. The seeds were clean and quite unharmed by their treatment, and I was able to collect even such minute and delicate seeds as those of *Juncus* and *Epilobium* from the Bielsbeck peat, though before boiling I had been obliged to break it with hammer and chisel.

Seeing the unexpected results of this treatment with strong soda solution, I was anxious to test whether we had really found a satisfactory method of dealing with recalcitrant peats, but no opportunity presented itself till a few weeks ago, when through the courtesy of Mr. Rankin, of the Storey Institute, Lancaster, I was enabled to test a specimen of a particularly difficult peat. Mr. Rankin had previously experimented with various methods, including Dr. Gunnar Andersson's nitric acid treatment, but with comparatively little success, and had come to the conclusion that "the best method, though laborious, was to go carefully over the dry peat and pick out the seeds with a needle, or dry it a little and tease it out under water." The specimen sent by Mr. Rankin was of a "swamp peat from the base of a high peat moor" near Lancaster. It weighed about 2 oz. I boiled it for two hours with its own weight of dehydrated soda, crushing it once slightly so as to allow the water to have access to all parts. This I did with a sort of pestle made by a flat piece of cork on the end of a stick. At the end of the time, the matted fibre appearing to be completely loosened, I poured the contents of the pan into a sieve of very fine mesh—we always use perforated zinc in preference to wire, as seeds are apt to get entangled in the wire and damaged—and held it under a tap, moving it slightly with the fingers now and again, so that the water could percolate freely. The matrix of humus had been either completely dissolved, or disintegrated to an exceedingly fine sediment, for the water which streamed off, though at the first dark brown in colour, flowed unimpeded through the sieve. After a few minutes the water ran through perfectly clean, and the contents of the sieve were completely loosened and separate. I therefore washed them into the middle of the sieve, inverted it over a bowl, and allowed water to run through it the wrong way. By this means the residue was washed into the bowl, where it was, as in the sample exhibited, clean, quite separate, and ready to be looked over with a dissecting microscope, and the vegetable and other remains in no way injured by their treatment.

The result of the examination by this method was that from the exceedingly small sample sent by Mr. Rankin, only 2 oz., I was able to pick out nearly three hundred specimens of moss, seeds, and insects, in a fit state to be determined.

The species of flowering plants represented are:—

Lychnis Flos-cuculi, *Linn.*	Scirpus pauciflorus, *Lightf.*
Menyanthes trifoliata, *Linn.*	„ fluitans, *Linn.*
Betula alba, *Linn.*	Carex 2 sp.
Cladium Mariscus, *R. Br.*	

Many specimens of moss.
Several elytra of beetles, and wings of flies.
A few fragments of charcoal, or carbonised wood.

This is a very large number of specimens to be derived from so very small a sample of peat. It is partly due to the richness of the deposit, but largely also to the completeness with which it was disintegrated and the ease with which all the individual constituents could be examined. And it would seem that by working peats in bulk by this method, an enormous supply of material for the study of their natural history may easily be obtained. Indeed, it would appear that the complete study of peat deposits would be limited rather by the great amount of material available, and the consequent great length of time required to work through it, than by the difficulty, hitherto so frequently felt, of treating peat so as to obtain any material at all.

Further, what is true of any other kind of deposit is true of peat, that if we are to gain an accurate knowledge of the flora contained in it, some such method of intimate examination is absolutely necessary. For it is not only the often recurring species, which formed the mass of vegetation growing on the spot, that we have to take into account. Peat, like all other deposits, contains over and above such vegetation, seeds of plants which have been carried into it by wind and other agencies, and except by such a minute inspection as we have been enabled to make, these chance comers would almost inevitably remain undiscovered. But it is frequently these very seeds which are the most interesting, and have most to tell us about the climate and physical conditions of the time. We have an instance of this in the present case, where the wind-borne birch-seed tells, that though the peat was laid down in a swamp, hard by there was drier ground where the birch-tree grew. That is, the swamp conditions were local, not general, and local conditions, not climate, must account for the nature of the vegetation.

The result of the experiment with this swamp peat was so encouraging that I was desirous still further to test the efficacy of the method, and at Mr. Reid's suggestion tried what could be done with the Eocene lignite of Bovey Tracey. This material, of which a sample is exhibited, is not a true peat, but is probably a reconstructed vegetable mould of tropical or sub-tropical formation. It is formed of decayed wood and other vegetable matter, together with a few seeds and a great quantity of structureless humus. The bulk of the material bears evidence of having been much decayed before its deposition. It is extremely hard and close-grained, and is burnt as lignite. I boiled a very small sample of this material for three hours with double its weight of dehydrated soda. The result was encouraging so far, that at the end of the time the water was dyed a deep brown, but the peat was not disintegrated. Next day I boiled it for twelve hours, the day after for ten hours, and the day following for eight hours, taking it off occasionally to examine what effect the treatment was having, to pick out any specimens which had become free and clean, and

to change the old solution for new. At the end of the time, after thirty-three hours' boiling, the humus was practically dissolved and the process of separation complete.

Unfortunately the specimen used in the experiment, the only one available at the time, is devoid of remains of much interest. Still I think the purpose for which the experiment was undertaken may be regarded as demonstrated, viz., that peats of any degree of obduracy may be disintegrated by the treatment described, provided a sufficiently strong soda solution be used, and a sufficiently long time be allowed for boiling. As far as I have tested the method, it is shown that, in any peat which does not need exceedingly strong solutions and long boiling, there is no danger of even the most delicate structures, such as leaves and fronds of ferns, being injured. With regard to the far more rigorous treatment accorded to the Bovey Tracey lignite, owing to the nature of the specimen examined, it is not easy to say what might be the effect on such structures, already much decayed. I found, however, small leaf-fragments and other delicate tissue. These, though not complete enough for identification, indicate by their state of preservation that, if they had been present in the lignite in a perfect condition, they would in all probability have been washed out uninjured. Without a doubt hard woody seeds would be preserved. We can tell this from the state in which we find the fragments of wood and other vegetable tissues.

During the above experiments, we found reason to believe that mineral impurities such as clay were disintegrated at the same time as the humus and possibly to some extent also the pyrites. It proved to be so. I took a small sample of highly fossiliferous pipe-clay from the Eocene beds of Bovey Tracey, and after boiling it for three hours with a large quantity of soda, found it was completely disintegrated, though a similar sample, boiled for a much longer time without soda, remained unaltered. The seeds and other vegetable remains collected from this small quantity of pipe-clay proved to be of the highest interest, and even the most delicate structures were found to be preserved in a perfect condition. Several of these seeds are, I believe, unrecorded from these deposits, though the sample examined weighed scarcely more than ¼ lb.

It is here that the interest of these investigations lies. We hope that by the use of this very simple process we may now have complete access to those deposits which hitherto it has been possible to examine only in the most imperfect manner, and to others which, owing to the extreme labour or even impossibility of disintegrating them, it has not been possible to examine at all. It is our wish to apply to such deposits the same methods of complete and intimate investigation which have long been used for deposits of sand and loam.

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[Synonyms and native names are printed in *italics*. A star is added to names which are ostensibly here published for the first time.]

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PRINTED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.

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